

APPROVED
by order of the Cabinet of Ministers of Ukraine
of June 25, 2024, No. 587-r

**NATIONAL ENERGY AND CLIMATE
PLAN
for the period until 2030**

LIST OF ABBREVIATIONS

CF	capacity factor
CHP	combined heat and power plant
CIF	critical infrastructure facilities
DSO	distribution system operator in electricity
EBRD	European Bank for Reconstruction and Development
ENTSO-E	European Network of Transmission System Operators for Electricity
ENTSOG	European Network of Transmission System Operators for Gas
ESCO	energy service company
ESS	energy storage system
ESU	Energy Strategy of Ukraine for the period until 2050
GDP	gross domestic product
GDS	gas distribution system
GDSO	gas distribution system operator
GHG	greenhouse gasses
GSSO	gas storage system operator
GTS	gas transmission system
GTSO	gas transmission system operator
HPP	hydroelectric power plant
HW	household waste
IEA	International Energy Agency
IEF	State Institution "Institute for Economics and Forecasting of the National Academy of Sciences of Ukraine"
ICE	internal combustion engine
LNG	liquefied natural gas
LPG	liquefied petroleum gas
LULUCF	land use, land use change and forestry
NDC	Nationally Determined Contribution of Ukraine
NECP	National Energy and Climate Plan for the period until 2030
NERP	National Emission Reduction Plan from Large Combustion Plants
NES	National Economic Strategy for the period until 2030
NEURC (Regulator)	National Energy and Utilities Regulatory Commission
NPP	nuclear power plant
NSDC	National Security and Defense Council of Ukraine
PHPP	pumped hydroelectric power plant
PL	power line
PSO	public service obligations

RAW	radioactive waste
RES	renewable energy sources
SAIDI	System Average Interruption Duration Index
SNF	spent nuclear fuel
SPP	solar power plant
TEN-E	Trans-European energy networks
TIMES	The Integrated MARKAL-EFOM System
toe	ton of oil equivalent
TPP	thermal power plant
TSO	transmission system operator in electricity
TYNDP	Union-wide Ten-Year Network Development Plan
UGS	underground gas storages
UES	United Energy System of Ukraine
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
VAT	value added tax
WAM	scenario with additional policies and measures
WEM	scenario with existing policies and measures
WPP	wind power plant

SECTION A. NATIONAL PLAN

1. OVERVIEW AND PROCESS FOR ESTABLISHING THE PLAN

1.1. Executive summary

i. Political, economic, environmental and social context of the plan

NECP is a strategic document aimed at harmonizing energy and climate policies to ensure sustainable development and recovery of Ukraine's economy.

The preparation of NECP is an obligation of Ukraine within the framework of the Treaty on the Establishment of the Energy Community¹ in accordance with the requirements of the Regulation (EU) 2018/1999 of the European Parliament and of the Council of 11 December 2018 on the Governance of the Energy Union and Climate Action, , amending Regulations (EC) No 663/2009 and (EC) No 715/2009 of the European Parliament and of the Council, Directives 94/22/EC, 98/70/EC, 2009/31/EC, 2009/73/EC, 2010/31/EU, 2012/27/EU and 2013/30/EU of the European Parliament and of the Council, Council Directives 2009/119/EC and (EU) 2015/652 and repealing Regulation (EU) No 525/2013 of the European Parliament and of the Council (hereinafter - Regulation (EU) 2018/1999) and the Commission Notice². The NECP was developed to implement the Decrees of the President of Ukraine of November 8, 2019, No. 837³ and of March 23, 2021 No. 111⁴. In addition, the development and approval of the NECP is a condition for the distribution of EU financial assistance within the framework of the Ukraine Facility.

The NECP was prepared in accordance with the clear requirements of the Regulation (EU) 2018/1999⁵, as well as taking into account the experience of preparing similar documents by the EU member states and the Contracting Parties of the Energy Community and previous developments⁶. The development of the draft NECP was carried out by a group of leading experts of DiXi Group think tank and the State Institution "Institute for Economics and Forecasting of the National Academy of Sciences of Ukraine" with the support of the UK Embassy (the project "Ukrainian national development and preparation for the implementation of the energy and climate plan") and the U.S. initiative Net Zero World .

On the part of the Government of Ukraine, the Ministry of Economy coordinates the development of the NECP. The Resolution of the Cabinet of Ministers of Ukraine of August 19, 2023, No. 924 (Official Gazette of Ukraine, 2023, No. 84, Article 4855) established an Interagency Working Group on Preparation of Proposals and Recommendations for the Development of the National Energy and Climate Plan⁷, to which are attached all key ministries and departments.

¹ <https://www.energy-community.org/legal/acquis.html>

² Communication from the European Commission on guidelines for Member States to update their national energy and climate plans for 2021-2030 (2022/C 495/02), <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX%3A52022XC1229%2802%29&from=EN>

³ <https://www.president.gov.ua/documents/8372019-30389>

⁴ <https://www.president.gov.ua/documents/1112021-37505>

⁵ https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv%3AOJ.L_.2018.328.01.0001.01.ENG

⁶ <https://www.lowcarbonukraine.com/uk/%D1%83%D1%80%D1%8F%D0%B4%D1%83-%D0%BF%D0%B5%D1%80%D0%B5%D0%B4%D0%B0%D0%BB%D0%B8-%D0%BF%D1%80%D0%BE%D1%94%D0%BA%D1%82-%D1%96%D0%BD%D1%82%D0%B5%D0%B3%D1%80%D0%BE%D0%B2%D0%B0%D0%BD%D0%BE%D0%B3%D0%BE/>

⁷ <https://zakon.rada.gov.ua/laws/show/924-2023-%D0%BF#Text>

At the same time, the full-scale invasion of the Russian Federation into Ukraine has a serious impact on the Ukrainian economy, in particular the energy sector. One of the most important aspects is the destruction of critical infrastructure facilities as a result of hostilities, which causes significant interruptions in the supply of electricity and gas, as well as disrupts the operation of district heating systems. Thus, only in the period from November 2022 to February 2023, on average, electricity supply was limited to 3.8 million consumers, and the maximum number of consumers cut off due to shelling during a system accident in the UES of Ukraine reached 13.5 million⁸. Further attacks on critical infrastructure facilities may exacerbate the energy crisis and limit access to key resources. In addition, hostilities affect the supply of labor and business activities.

In general, from the beginning of the full-scale aggression until the end of the autumn-winter period of 2022/2023, about 50% of available generating capacities and transformer substations of the transmission system of Ukrenergo were temporarily lost (damaged and occupied). According to the assessment of the Kyiv School of Economics (KSE) in accordance with the methodology of the World Bank, as of May 2024, as a result of the full-scale invasion of the Russian Federation on the territory of Ukraine, the energy sector suffered direct losses and indirect financial losses in the amount of 56.5 billion USD, while the needs for recovery, which provide for the complete reconstruction of destroyed facilities under the principle "Build Back Better" amounted to 50.5 billion USD. More than 18 GW of generating capacity was occupied, the Kakhovska and Dniprovska HPPs, the Zmiivska and Trypil'ska TPPs were completely destroyed, and other TPPs suffered critical damage. About half of the high-voltage substations of the electricity transmission system were damaged, all oil refineries and a significant part of the infrastructure for the storage of crude oil and petroleum products were actually destroyed⁹. As a result of the full-scale invasion of the Russian Federation into Ukraine from February 2022, the consumption of natural gas (-28.7% in 2022 compared to 2021) and electricity (-30-35%), as well as the production of natural gas (- 6.7% in 2022 compared to 2021) have decreased.

With the beginning of the full-scale invasion of the Russian Federation into Ukraine, the number of cyberattacks increased dramatically - in the first 47 days alone, 200,000 events related to cyber security¹⁰ were recorded, and from January 2022 to September 2023, CERT-UA recorded almost 4,000 cyber incidents¹¹. Most cyberattacks occur in the electricity sector. For example, the hacker group Sandworm, associated with the special services of the Russian Federation, by cyberattacks on October 10 and 12, 2022, increased the effect of massive missile attacks on the energy system of Ukraine¹².

As of the beginning of 2024, the estimated damage caused to the environment exceeded 56 billion EUR, with more than 3,300 documented legal cases¹³. The prosecutor's office was investigating 280 criminal cases of ecocide and environmental war crimes.

Thus, the main problems of the development and implementation of NECP are:

- Continuation of hostilities and the need to take into account their consequences, uncertainty about the scale of the destruction and the pace of recovery, which directly affects the possibility of implementing certain defined policies and measures, the pace of their implementation and success;

⁸ <https://mev.gov.ua/sites/default/files/field/file/proekt-rozporядzhennya.pdf>

⁹ <https://www.undp.org/ukraine/publications/ukraine-energy-damage-assessment>
<https://kse.ua/ua/about-the-school/news/zbitki-ta-vtrati-energetichnogo-sektoru-ukrayini-vnaslidok-povnomasshtabnogo-vtorgnennya-rosiyi-perevishhili-56-mlrd-otsinka-kse-institute-sta-nom-na-traven-2024-roku>

¹⁰

<https://www.kmu.gov.ua/news/z-pochatku-vijni-shchodnya-fiksuyemo-v-serednomu-ponad-4-tisyachi-spr-ob-kiberatak-u-sferi-energetiki-farid-safarov>

¹¹ <https://home.treasury.gov/news/press-releases/jy1922>

¹² <https://www.mandiant.com/resources/blog/sandworm-disrupts-power-ukraine-operational-technology>

¹³ <https://president.gov.ua/news/andrij-vermak-i-margot-valstrem-proveli-pyate-zasidannya-miz-88149>

- Economic recession and associated energy poverty, leading to political reluctance to apply market pricing mechanisms for energy resources and related services;
- Weakened capacity of state institutions to simultaneously carry out crisis management in the conditions of hostilities along with the performance of their key functions of development and implementation of public policy in the fields of energy and climate, especially taking into account the reforms challenge in accordance with the requirements of EU legislation;
- Large-scale debt accumulated in the supply chains of natural gas and electricity, which requires comprehensive settlement at the state level.

ii. Strategy relating to the five dimensions of the Energy Union

Ukraine has a developed system of legislation and regulation, as well as a fairly wide set of policies and measures in the fields of energy, climate and related areas. Both at the national level and at the regional level (within the Energy Community), Ukraine has defined key goals by 2030, in particular:

- Reduction of greenhouse gas emissions by 65% as compared to the 1990 level;
- The share of renewable energy sources in total final energy consumption is at least 27%;
- Primary energy consumption is no more than 72.224 Mtoe, final energy consumption - than 42.168 Mtoe;
- The forecasted energy savings in the buildings of state authorities is not less than 21.4 toe per year;
- Reduction of the level of import dependence (gross imports in the total primary energy supply) to 33%;
- Deepening the diversification of sources and routes of energy supply - no more than 30% from a single supplier;
- Complete and comprehensive integration of the electricity and natural gas markets of Ukraine with the European market;
- Free pricing on energy markets with mechanisms to support vulnerable consumers;
- Development and financing of innovation and research in the sector of clean technologies, renewable energy and low-carbon production;
- Increasing competitiveness;
- Climate neutrality of the energy sector by 2050.

At the same time, issues of completeness (sufficiency), relevance and harmonization of policies and measures aimed at achieving the main strategic goals come to the foreground, especially given the need to build a full-fledged climate governance architecture taking into account the standards of sustainable corporate governance. Actually, the NECP is aimed at harmonizing energy and climate policies, filling gaps and adjusting the content of individual measures to achieve the defined goals.

A detailed overview of key energy and climate policies and measures related to the five dimensions of the Energy Union is presented in section 1.2.ii. The development of modeling scenarios in accordance with the requirements of the Regulation (EU) 2018/1999 took place taking into account the peculiarities of public administration in Ukraine (see Appendix 1 for details).

iii. Overview table with key objectives, policies and measures of the plan

Dimension	Objectives	Existing policies and measures (WEM scenario)	Planned policies and measures (WAM scenario)
Decarbonization	- Reduction of GHG emissions by 65% compared to 1990 level by 2030 - Climate neutrality of the energy sector of Ukraine by 2050 - Climate neutrality (for the economy as a whole) by 2060 - Decommissioning of coal-fired generation by 2035 - Reducing methane emissions by 30% compared to 2020 level by 2030. - Strengthening the adaptive capacity and resilience of social, economic and environmental systems to climate change - The share of renewable energy sources in the total final energy consumption should be at least 27% in 2030 - The share of RES in the total electricity generation at the level of 25% in 2030 - The share of alternative energy sources (renewable energy sources and secondary energy resources) in the production of thermal energy by installations in the field of heat supply in 2025 – 30%, in 2035 – 40% - Increasing the level of use of alternative fuels (biofuel or its mixture with traditional fuel) and electricity (produced from both traditional and renewable sources) in the transport sector to 50% by 2030	PM_D_WEM_01 Environmental tax levied on carbon dioxide emissions PM_D_WEM_02 "Green" tariff for renewable electricity producers PM_D_WEM_03 Incentive tariff for thermal energy producers from RES PM_D_WEM_04 Tax benefits for importing RES equipment PM_D_WEM_05 Market premium mechanism for renewable electricity producers (feed-in premium) PM_D_WEM_06 Direct electricity purchase and sale contracts between producers and final energy consumers (corporate PPAs) PM_D_WEM_07 "GreenDIM" Energy Efficiency Fund Program PM_D_WEM_08 Tax benefits for vehicles equipped with electric motors PM_D_WEM_09 Stimulating the development of electric charging infrastructure PM_D_WEM_10 Stimulating the development of low-carbon municipal transport	PM_D_WAM_01 National Emission Reduction Plan from Large Combustion Plants PM_D_WAM_02 National GHG Emissions Trading System PM_D_WAM_03 Action plan for the implementation of Ukraine's climate policy within the framework of participation in the global initiative to reduce methane emissions "Global Methane Pledge" PM_D_WAM_04 Promoting the development of organic crop production PM_D_WAM_05 Disseminating the use of information and electronic communication technologies in crop production PM_D_WAM_06 Demining and reforestation after hostilities PM_D_WAM_07 Nationwide targeted program of land use and protection PM_D_WAM_08 Disseminating the practice of household waste components reuse PM_D_WAM_09 Disseminating the practice of household waste recycling PM_D_WAM_10 Disseminating the practice of household waste organic components composting PM_D_WAM_11 Disseminating the practice of thermal treatment of household waste (with obtaining useful energy) PM_D_WAM_12 Increasing the amount of disposal (recovery and flaring) of biogas at landfills PM_D_WAM_13 System of auctions for distribution of support quota for RES PM_D_WAM_14 Guarantees of origin of electricity from RES PM_D_WAM_15 Mandatory use of liquid biofuel (biocomponents) in the field of transport, which meets sustainability criteria PM_D_WAM_16 Implementation of unified electronic trade in solid biofuels PM_D_WAM_17 Development of the energy crops sector

			PM_D_WAM_18 Simplification of permit procedures for RES projects PM_D_WAM_19 State target program for the just transition of coal regions of Ukraine for the period until 2030 PM_D_WAM_20 Implementation of climate change adaptation measures at the national and local levels
Energy efficiency	- Primary energy consumption in 2030 should not exceed 72,224 thousand toe, and final energy consumption should not exceed 42,168 thousand toe. - The total amount of energy saved in the final use for the years 2021-2030 should be at least 17,300 thousand toe. - The expected energy saving in the buildings of state authorities is at least 21.4 toe/year	PM_EE_WEM_01 Activities of the Energy Efficiency Fund PM_EE_WEM_02 Decarbonisation and Energy-Efficient Transformation Fund PM_EE_WEM_03 Energy service in the public sector PM_EE_WEM_04 Minimum requirements for energy efficiency of buildings PM_EE_WEM_05 Certification of energy efficiency of buildings PM_EE_WEM_06 Exemplary role of buildings of state authorities PM_EE_WEM_07 National database of energy and operational characteristics of buildings PM_EE_WEM_08 Energy management in state authorities PM_EE_WEM_09 Energy management in local self-government bodies PM_EE_WEM_10 Local energy plans PM_EE_WEM_11 Regional offices for decarbonisation and energy efficiency PM_EE_WEM_12 Energy-efficient procurement PM_EE_WEM_13 Energy labeling and ecodesign PM_EE_WEM_14 Experimental project on creating favorable conditions for ensuring efficient consumption of electricity in Ukraine PM_EE_WEM_15 Energy audit of large enterprises PM_EE_WEM_16 Intelligent energy accounting systems PM_EE_WEM_17 Regulation of the combined production of heat and electricity (cogeneration) PM_EE_WEM_18 Heat supply schemes PM_EE_WEM_19 Qualification of cogeneration plants	PM_EE_WAM_01 Scheme of obligations on energy efficiency PM_EE_WAM_02 State targeted economic program to support thermal modernisation of buildings until 2030 PM_EE_WAM_03 Nearly-zero energy buildings PM_EE_WAM_04 Assessment of the energy efficiency potential of the gas transportation system, electricity transmission system, gas distribution system, electricity distribution system PM_EE_WAM_05 Update of the Concept of implementation of state policy in the field of heat supply PM_EE_WAM_06 Improvement of the model of state regulation in the field of heat supply PM_EE_WAM_07 Settlement of debts of heat supply enterprises for consumed natural gas PM_EE_WAM_08 Assessment of the application potential of efficient district heating and highly efficient cogeneration PM_EE_WAM_09 Guarantees of the origin of electricity produced by a highly efficient cogeneration plant PM_EE_WAM_10 Stimulation of the development of highly efficient cogeneration PM_EE_WAM_11 Update of the Concept of implementation of state policy in the field of heat supply PM_EE_WAM_12 Implementation of the State Targeted Economic Program for the Energy Modernisation of State- or Municipal-Owned Heat Producers for the Period Until 2030

		PM_EE_WEM_20 Provision of thermal energy accounting	
Energy security	- Reduction of import dependence (gross imports in TPES) to 33% - Deepening the diversification of sources and routes of supplying energy resources from third countries - ensuring diversification of supplies at the level of no more than 30% from a single supplier, - reducing the share of a single supplier in the nuclear fuel market to 60% - Increasing the flexibility of the national energy system - Eliminating restrictions or interruptions in the supply of energy resources in order to increase resilience	PM_ES_WEM_01 Development of routes for the imports of petroleum products and natural gas PM_ES_WEM_02 Creation of fuel assemblies production capacity to meet at least 50% of the needs of Ukrainian nuclear power plants PM_ES_WEM_03 Creation of gas reserves (filling of gas storages) PM_ES_WEM_04 Creation of coal and backup fuel (fuel oil) reserves PM_ES_WEM_05 Implementation of the first standard of conduct for gas infrastructure facilities (N-1 Standard), standards of conduct for gas suppliers PM_ES_WEM_06 Fulfillment of the minimum criteria for the security of electricity supply PM_ES_WEM_07 Creation of a national system for the protection of CIF of the energy sector PM_ES_WEM_08 Experiment on the construction, repair and other engineering and technical measures for the protection of CIF PM_ES_WEM_09 Financial reserve for the decommissioning of nuclear installations PM_ES_WEM_10 Management of spent nuclear fuel (SNF) and radioactive waste (RAW)	PM_ES_WAM_01 Incentives for increasing gas production for maximum self-sufficiency PM_ES_WAM_02 Restoration of oil refining and/or construction of a new refining complex PM_ES_WAM_03 Creation of fuel assemblies production capacity to meet all the needs of Ukrainian nuclear power plants PM_ES_WAM_04 Development of uranium production PM_ES_WAM_05 Creation of minimum stocks of crude oil and petroleum products PM_ES_WAM_06 Implementation of EU rules on security of electricity and gas supply PM_ES_WAM_07 Provision of physical, engineering, technical and cyber protection of 100% CIF of the energy sector PM_ES_WAM_08 Creation of backup power sources of CIF, including using distributed renewable energy generation
Internal energy market (common objectives, policies and measures)	- Full and comprehensive integration with European energy markets - Market-based energy pricing for all categories of consumers - Effective mechanisms of support for vulnerable segments of the population - Achieving performance indicators of wholesale and retail markets	PM_IM_WEM_01 Current procedures for energy infrastructure development planning PM_IM_WEM_02 Provision of targeted subsidies for partial compensation of costs of housing and utility services PM_IM_WEM_03 Regulation and liberalization of retail prices PM_IM_WEM_04 Universal Service Supplier and Supplier of Last Resort PM_IM_WEM_05 Ensuring consumer access to important information PM_IM_WEM_06 Application of tools to facilitate comparison of commercial offers and consumer choice PM_IM_WEM_07 Simplified procedure for supplier switching	PM_IM_WAM_01 Development mechanisms of new interconnectors PM_IM_WAM_02 Additional procedures for energy infrastructure development planning PM_IM_WAM_03 Ensuring the independence of the NEURC PM_IM_WAM_04 Institutional protection of vulnerable consumers PM_IM_WAM_05 Application of online services for consumers (eConsumer) PM_IM_WAM_06 Measures to monitor and overcome energy poverty

		PM_IM_WEM_08 Development of organized wholesale energy markets	
Internal energy market: electricity	- Integration of the energy system of Ukraine with ENTSO-E countries (interconnectivity) at the level of 10% by 2030 - Adequacy and flexibility of the power system - Implementation of smart metering of electricity and smart grids - Reducing the average duration of power outages (SAIDI) to 150 minutes in urban areas and 300 minutes in rural areas (by 2050)	PM_IME_WEM_01 Stimulating regulation of distribution system operators PM_IME_WEM_02 Support of active consumers by self-production mechanism (net billing) PM_IME_WEM_03 Simplification and streamlining of permitting procedures for distributed generation facilities (temporary measures) PM_IME_WEM_04 Prioritization of RES facilities in dispatching PM_IME_WEM_05 Compensation for curtailment of RES producers (under the “green” tariff) in re-dispatching PM_IME_WEM_06 Harmonization of price caps on wholesale market segments PM_IME_WEM_07 Possibility for RES producers to choose the form of participation in the market and to freely switch between them PM_IME_WEM_08 Non-discriminatory integration of demand-side management, energy storage and aggregation into the energy system and market PM_IME_WEM_09 Service quality standards and compensation to consumers for non-compliance PM_IME_WEM_10 Supply of electricity to protected consumers PM_IME_WEM_11 Time-differentiated prices for household consumers PM_IME_WEM_12 Dynamic prices for non-household consumers	PM_IME_WAM_01 Implementation of smart grids PM_IME_WAM_02 Development of aggregation PM_IME_WAM_03 Pilot projects and demand-side management programs PM_IME_WAM_04 Ensuring the development of energy storage facilities PM_IME_WAM_05 Stimulation of the development of distributed electricity generation from renewables for the period up to 2030 PM_IME_WAM_06 Roadmap for Development of Distributed Generation PM_IME_WAM_07 Tenders for the construction of generating capacity and implementation of demand-side management PM_IME_WAM_08 Implementation of real-time pricing PM_IME_WAM_09 Integration of spot markets (market coupling) PM_IME_WAM_10 Integration (coupling) of the balancing market

Internal energy market: gas (including biomethane, hydrogen, oil)	• Increasing and promoting biomethane production • Ensuring 100% gas metering • Reliability and completeness of commercial gas accounting • Achieving sufficient volumes of domestic natural gas production	PM_IMG_WEM_01 Current measures to ensure production of sufficient volumes of natural gas PM_IMG_WEM_02 Creation of a technical safety system on the gas market PM_IMG_WEM_03 Transition to commercial gas accounting in energy units PM_IMG_WEM_04 Ensuring the attractiveness of the Ukrainian oil and gas infrastructure for use by foreign customers PM_IMG_WEM_05 Current measures to promote biomethane production PM_IMG_WEM_06 Basic annual offer of natural gas supplier	PM_IMG_WAM_01 Creation of a regulatory framework for the formation of future markets and the construction of their infrastructure PM_IMG_WAM_02 Creation of legal conditions for optimization of oil and gas infrastructure PM_IMG_WAM_03 Establishing systematic involvement of the Ukrainian side in EU processes related to the future of energy infrastructure PM_IMG_WAM_04 Additional measures to ensure production of sufficient volumes of natural gas PM_IMG_WAM_05 Opening of natural gas export PM_IMG_WAM_06 Determination of optimal technical parameters for gas injection into networks PM_IMG_WAM_07 Ensuring an effective regime of GDSO management PM_IMG_WAM_08 Setting up effective balancing rules PM_IMG_WAM_09 Additional measures to promote biomethane production PM_IMG_WAM_10 Additional measures for the development of the organized wholesale gas market PM_IMG_WAM_11 Strengthening requirements for unbundling of GDSO PM_IMG_WAM_12 Ensuring 100% gas metering PM_IMG_WAM_13 Creation of a commercial gas accounting system PM_IMG_WAM_14 Creation of conditions for the use of contractual practice of voluntary consumption reduction

Research, innovation and competitiveness	• Development and financing of innovation and research in the sector of clean technologies, renewable energy and low-carbon production • Implementation of clean energy solutions and low-carbon technologies • Increasing competitiveness	PM_RIC_WEM_01 Modernization of educational programs in order to cover the skills gap in the field of green transition and renewable energy PM_RIC_WEM_02 Availability of grant funding for scientific research in the field of renewable energy and climate innovation PM_RIC_WEM_03 Development of corporate investments in the purchase of climate technologies and renewable energy solutions PM_RIC_WEM_04 Competitiveness of the Ukrainian economy and key industrial clusters against the background of the implementation of EU legislation in the field of energy labeling and ecodesign	PM_RIC_WAM_01 Development of corporate and international partnerships in the energy and climate sector PM_RIC_WAM_02 Expansion of funding for scientific research in the field of renewable energy and climate innovation PM_RIC_WAM_03 Active attraction of venture capital investments in climate innovation and renewable energy sector companies PM_RIC_WAM_04 Development of exports of climate and renewable energy technologies PM_RIC_WAM_05 Promoting the competitiveness of SMEs through green transformation and access to new markets

1.2. Overview of current policy situation

i. National and Energy Community energy system and policy context of the national plan

As a Contracting Party of the Energy Community, as well as within the process of accession to the EU, Ukraine undertook the commitment to develop NECP in accordance with Regulation (EC) 2018/1999 and the notification of the European Commission.

Since 2016, Ukraine has been working on the implementation of the Association Agreement between Ukraine and the EU, including the Deep and Comprehensive Free Trade Area. According to the assessment of the Cabinet of Ministers of Ukraine¹⁴ as of 2023, 77% of the obligations stipulated by the Agreement have been fulfilled, in particular: in the field of energy - 78%, environment and civil protection - 80%, energy efficiency, housing and utilities - 78%.

On February 28, 2022, Ukraine officially applied for membership in the European Union. On March 1, 2022, the European Parliament adopted a resolution supporting granting Ukraine the status of a candidate for EU membership, and on March 10-11, 2022, at the informal summit of the European Council in Versailles, EU leaders recognized the European prospects and the European choice of Ukraine, as specified in the Association Agreement and supported the decision of the EU Council to invite the Commission to provide its opinion on this application in accordance with the provisions of the relevant treaties. On April 17, 2022, Ukraine submitted answers to the European Commission's Questionnaire on Ukraine's compliance with the political and economic criteria for EU membership, on May 9 - the second part of the Questionnaire on the compliance of Ukrainian legislation, institutions and practice with EU law in 33 areas. The EU decision to grant Ukraine the official status of a candidate country was adopted on June 23, 2022.

The European Commission, in its Enlargement Package report, published at the beginning of November 2023¹⁵, noted Ukraine's significant progress on sections of the EU acquis. In particular, a good level of preparation in the energy sector and the achievement of certain progress were noted, despite the fact that the energy sector was operating in extraordinary conditions due to the attacks of the Russian Federation on the energy infrastructure of Ukraine. Harmonization of Ukrainian legislation with EU legislation continued, in particular with regard to the integrity and transparency of the wholesale energy market, renewable energy sources, GTSO and GSSO certification. However, measures taken under martial law led to a decrease in transparency and independence of stakeholders (in particular, the Regulator). In the areas of environmental protection and climate policy, Ukraine has a certain level of preparation and good progress has been achieved. Regarding the environment, adopted legislation was aimed at further harmonization in horizontal issues, water quality, waste management, chemicals and noise. However, the progress on climate policy has been limited.

The report on the implementation of obligations under the Energy Community Treaty for 2023¹⁶ contains an assessment of Ukraine's implementation of the Energy Community acquis for the period from November 2022 to October 2023 in 5 main areas (clusters). Ukraine as a whole is marked by one of the highest indicators: progress in implementation under the cluster "Energy Markets and Integration" is estimated at the level of 69%, "Decarbonization of the energy sector" - at the level of 44%, "Ensuring energy security" - at the level of 61%, "Environmental protection" - at the level of 52%, "Activity of regulatory bodies" - at the level of 76%.

¹⁴ https://www.kmu.gov.ua/storage/app/sites/1/55-GOEEL/zvit-pro-vykonannia-ua-za-2023_UA_2.pdf

¹⁵

https://neighbourhood-enlargement.ec.europa.eu/system/files/2023-11/SWD_2023_699%20Ukraine%20report.pdf

¹⁶ <https://www.energy-community.org/implementation/report.html>

On December 14, 2023, the EU leaders made a historic decision to start negotiations with Ukraine regarding the EU accession. The European Commission, without further delay, begins to prepare the technical aspects of the negotiations (the so-called negotiating framework).

At the beginning of 2024, the European Council supported the revision of the EU budget, which provides for 50 billion EUR for macro-financial support of Ukraine within the framework of the Ukraine Facility program during 2024-2027. The Ukraine Facility program envisages provision of 38.27 billion EUR to the state budget of Ukraine to strengthen macro-financial stability, as well as 6.97 billion EUR through a special investment instrument to cover the risks of investors in priority sectors through the EBRD, EIB and other international institutions¹⁷. It is expected that the implementation of projects within the framework of this instrument will attract additional 30 billion EUR of investments. The Ukraine Facility also provides 4.76 billion EUR for technical and administrative support, including funds to cover interest on loans.

Support will be provided quarterly for the fulfilling of indicators for the implementation of reforms provided for in the Ukraine Plan, approved by the Order of the Cabinet of Ministers of Ukraine of March 18, 2024, No. 244-r (Official Gazette of Ukraine, 2024, No. 32, Article 2035). The plan envisages the implementation of structural reforms in the public sector, the implementation of a number of economic reforms aimed at the development of the business climate and entrepreneurship, as well as steps for the development of priority sectors that can ensure rapid economic growth.

ii. Current energy and climate policies and measures relating to the five dimensions of the Energy Union

Decarbonization (reduction of greenhouse gas emissions)

Ukraine ratified¹⁸ the Paris Agreement¹⁹ as one of the first (July 14, 2016). The agreement entered into force on 4 November 2016, the thirtieth day after its ratification by the 55 Parties to the United Nations Framework Convention on Climate Change²⁰, which are estimated to collectively account for at least 55% of total global greenhouse gas (GHG) emissions.

To implement the Paris Agreement, Parties are required to prepare, report and maintain consistent nationally determined contributions to the global response to climate change. The expected nationally determined contribution of Ukraine, which was approved by the order of the Cabinet of Ministers of Ukraine "On the approval of the expected nationally determined contribution of Ukraine to the project of the new global climate agreement" of September 16, 2015 No. 980 (Government Courier, 2015, No. 179)²¹, after the entry into force of the Paris Agreement, automatically became the first nationally determined contribution (NDC) of Ukraine.

According to the first NDC, Ukraine undertook a commitment to not exceed 60% of the 1990 level of greenhouse gas emissions in 2030²². Given that in 2012, Ukraine's GHG emissions were at the level of 375.4 million tons of CO₂-eq. (taking into account the LULUCF), which was 42.9% of the level of emissions in 1990, it was assumed that by 2030 Ukraine's GHG emissions may increase after the restoration of the territorial integrity of the country and the economy.

The updated nationally determined contribution of Ukraine to the Paris Agreement, which was approved by the order of the Cabinet of Ministers of Ukraine of July 30, 2021 No. 868 "On the approval of the updated nationally determined contribution of Ukraine to the Paris Agreement" (Official Gazette of Ukraine, 2021 p. No. 62, Art. 3956)²³,

¹⁷ <https://www.ukrainefacility.me.gov.ua/>

¹⁸ Law of Ukraine "On Ratification of the Paris Agreement" of July 14, 2016 No. 1469-VIII, <https://zakon.rada.gov.ua/laws/show/1469-19#Text>

¹⁹ https://zakon.rada.gov.ua/laws/show/995_161#Text

²⁰ https://zakon.rada.gov.ua/laws/show/995_044#Text

²¹ <https://zakon.rada.gov.ua/laws/show/980-2015-%D1%80#Text>

²²

https://www4.unfccc.int/sites/submissions/INDC/Published%20Documents/Ukraine/1/150930_Ukraine_INDC.pdf

²³ <https://zakon.rada.gov.ua/laws/show/868-2021-%D1%80#Text>

significantly strengthened²⁴ Ukraine's contribution to overcoming global climate change. Thus, the document envisages a reduction of Ukraine's total GHG emissions by 65% compared to the 1990 level²⁵ by 2030. The same goal is stated in the Decision of the Council of Ministers of the Energy Community 2022/02/MC-En²⁶.

The Decree of the Cabinet of Ministers of Ukraine of May 30, 2024 No. 483-r approved the Strategy for the Development and Implementation of State Policy in the Field of Climate Change for the Period Until 2035 and the Operational Plan of Measures for Its Implementation in 2024-2026²⁷, which was developed with the aim of establishment of organizational and legal foundations for the development and implementation of state policy in the field of climate change in order to achieve sustainable development and ensure an effective transition to low-carbon development of the state under the conditions of economic, energy, food and environmental security, increase the level of well-being of citizens, reduce the effects and consequences of climate change and for taking into account the goals of the state climate policy during the post-war reconstruction of Ukraine.

In addition, the Verkhovna Rada registered a draft of the Law of Ukraine "On the Basic Principles of State Climate Policy" (Reg. No. 11310 of May 31, 2024)²⁸, the purpose of which is to define the legal and organizational principles of state climate policy aimed at ensuring low-carbon development of Ukraine, the achievement of climate neutrality, adaptation to climate change, the fulfillment of Ukraine's international obligations in the specified area, as well as the principles of improving the national system of inventorying anthropogenic emissions from sources of greenhouse gas emissions and absorption by sinks of greenhouse gases, the functioning of the national system for tracking the implementation of policies and measures and forecasting in the field of climate change. Among other things, the draft law defines mechanisms and tools for achieving climate goals and provides for the development of Sectoral Program Documents for reducing greenhouse gas emissions and increasing their removal in relevant sectors of the economy and/or spheres of state policy, as well as Sectoral Program Documents for adaptation to climate change.

Ukraine has been a party to the Montreal Protocol since 1988 and faithfully fulfills its obligations. In particular, the state is regulating economic activity with ozone-depleting substances and fluorinated greenhouse gases. In 2020, the relevant Law of Ukraine²⁹ "On the Regulation of Economic Activities with Ozone-Depleting Substances and Fluorinated Greenhouse Gases" was adopted, which regulates legal relations regarding the production, import, export, storage, use, placement on the market and handling of ozone-depleting substances, fluorinated greenhouse gases, and goods and equipment that contain or use them, which affects the ozone layer and the level of global warming, as well as a number of other normative legal acts in this area. The National Action Plan for the Environmental Protection for the Period Until 2025³⁰, which was approved by the Decree of the Cabinet of Ministers of Ukraine of April 21, 2021 No. 443-r "On the Approval of the National Action Plan for the Environmental Protection for the Period Until 2025" (Official Gazette of Ukraine, 2021 p., No. 42, Article 2557), envisions the establishment and maintenance of the Unified State Register of Operators of Controlled Substances (ozone-depleting substances and fluorinated greenhouse gases) during 2021-2025.

²⁴ The first NDC actually envisaged a reduction of GHG emissions by 40% by 2030 from the 1990 level. The updated NDC increased the GHG emissions reduction target to 65% of 1990 levels.

²⁵ https://unfccc.int/sites/default/files/NDC/2022-06/Ukraine%20NDC_July%2031.pdf

²⁶ <https://www.energy-community.org/legal/decisions.html>

²⁷ <https://zakon.rada.gov.ua/laws/show/483-2024-%D1%80#Text>

²⁸ <https://itd.rada.gov.ua/billInfo/Bills/Card/44348>

²⁹ Law of Ukraine "On Regulation of Economic Activities with Ozone Depleting Substances and Fluorinated Greenhouse Gases" No. 376-IX of December 12, 2019, <https://zakon.rada.gov.ua/laws/show/376-20#Text>

³⁰ <https://zakon.rada.gov.ua/laws/show/443-2021-%D1%80#n12>

The Ministry of Environment developed draft³¹ Law of Ukraine for the ratification of the Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer, which was adopted at the twenty-eighth Meeting of the Parties to the Montreal Protocol on October 15, 2016 in Kigali, Rwanda (hereinafter - the Kigali Amendment), regarding the gradual reduction of consumption of fluorinated greenhouse gases, which have a significant impact on the climate. After the completion of the ratification process of the Kigali Amendment, the development and approval of the Strategy for the reduction of emissions of ozone-depleting substances and fluorinated GHGs is expected, which should be done during 2024-25.

For countries that do not act within the framework of Article 5 of the Montreal Protocol (in particular, Ukraine), the Kigali Amendment provides for a gradual reduction in the consumption of hydrofluorocarbons (HFCs), and the initial stage for them is a reduction in consumption by 10%. There are 5 consumption reduction stages for the following countries: (Stage 1 (2019) – 10%, Stage 2 (2024) – 40%, Stage 3 (2029) – 70%, Stage 4 (2034) – 80%, Stage 5 (2036) – 85%. Taking into account this schedule and the fact that the ratification of the Kigali Amendment in Ukraine is planned for 2024, the goal of reducing the use of HFCs will be set immediately by 40%. For Ukraine, the base level of consumption is calculated based on the indicators of the average level of production/consumption of HFCs in 2011, 2012 and 2013 plus 15% of the base level of production/consumption of HCFC. Currently, a baseline is being calculated for Ukraine, from which the reduction in the use of HFCs will occur.

Decarbonization (development of renewable energy sources)

The main documents establishing the legislative framework for renewable energy sources are the laws of Ukraine "On Alternative Energy Sources"³² and "On Alternative Fuels"³³. These laws transposed part of the provisions of Directive (EU) 2018/2001 of December 11, 2018 on the promotion of the use of energy from renewable sources into Ukrainian legislation.

Since 2009, the development of renewable energy sources in the electricity sector has been due to the introduction of a fixed "green" tariff (feed-in tariff) model. Thus, as of the beginning of 2022, the total volume of installed capacity of renewable energy facilities for "green" tariff amounted to more than 9.5 GW (10.1 GW taking into account facilities occupied until February 24, 2022), and the volume of investments in the industry exceeded 12 billion US dollars.

At the same time, the support system based on the "green" tariff model, due to the lack of feedback and market pricing mechanisms, did not form a sustainable approach to the development of renewable energy in Ukraine. The rapid, more than tripled growth of electricity production from alternative energy sources during 2019-2021 has created a number of economic and technical challenges associated with both the lack of a sustainable financial system of payment for electricity produced from renewable sources and limited opportunities of the unified energy system of Ukraine to the integration of renewable energy facilities.

In October 2019, the Government started public discussions with all interested parties in order to resolve problematic issues in the field of renewable energy. The process involved the Dispute Resolution and Negotiation Center of the Energy Community Secretariat as a mediator, as a result of which compromise agreements were reached, outlined in the Memorandum on mutual understanding regarding the settlement of problematic issues in the field of renewable energy in Ukraine.

³¹

<https://mepr.gov.ua/povidomlennya-pro-oprylyudnennya-proyektu-zakonu-ukrayiny-pro-ratyfikatsiyu-popravky-d-o-monrealskogo-protokolu-pro-rechovyny-shho-rujnuuyut-ozonovyy-shar/>

³² <https://zakon.rada.gov.ua/laws/show/555-IV#Text>

³³ <https://zakon.rada.gov.ua/laws/show/1391-14#Text>

The key ones are: on the part of investors - voluntary agreement to reduce "green" tariffs, increase responsibility for imbalances, limit the terms of putting solar power plants into operation according to the "green" tariff model; on the part of the state - ensuring stable current payment for the generated electricity, repayment of accumulated debt and promotion of further development of the industry on a competitive basis.

Given the difficult situation in the industry, Ukraine did not go for a unilateral reduction of "green" tariffs, but reached a settlement of this issue through long negotiations with investors, search for compromises and conclusion of the Memorandum, which became the basis of the relevant law of Ukraine.

Since that time, Ukraine has ensured repayment of debt to investors in renewable generation. Currently, the relevant problematic issues are related to the challenges facing the energy system, in connection with the full-scale invasion of the Russian Federation into Ukraine.

At the end of 2021, as part of the Treaty on the Establishment of the Energy Community (decision of the Council of Ministers of the Energy Community of November 30, 2021 No. 2021/14/MC-EnC), Ukraine undertook the commitment to implement the fourth energy package "Clean Energy for Europeans", which includes Directive (EC) 2018/2001 of December 11, 2018 "On the promotion of the use of energy from renewable sources" (RED II).

In October 2023, the EU approved EU Directive 2023/2413, which updated the provisions of RED II, and since then the Directive has received the name RED III, which, in particular, provides for an increase in the share of energy from RES. In the case of Ukraine's accession to the EU, Ukraine will potentially also have to implement the provisions of the RED III Directive and the corresponding delegated regulations, which are stricter than the current requirements for the Energy Community member states. Currently, the Government is working on the development of a draft law on the comprehensive implementation of the requirements of European legislation in the field of renewable energy development.

The National Economic Strategy of Ukraine for the period until 2030, approved by the Resolution of the Cabinet of Ministers of Ukraine of March 3, 2021 No. 179 (Official Gazette of Ukraine, 2021 p., No. 22, Article 1015) (hereinafter - NES), defines one of the key guidelines in the economic policy of Ukraine, the decarbonization of the economy (increasing energy efficiency, development of renewable energy sources, development of circular economy and synchronization with the "European Green Course" initiative).

Further, the order of the Cabinet of Ministers of Ukraine of April 21, 2023 No. 373 (Official Gazette of Ukraine, 2023 p., No. 47, Article 2575) approved the Energy Strategy of Ukraine for the period until 2050 (hereinafter - ESU)³⁴, which, in particular, determines the indicative indicators of the future development of renewable energy. Among them: achieving a share of 27% of energy produced from renewable energy sources in total final energy consumption by 2030, 70% of energy from renewable sources in total primary energy supply by 2050 and reaching climate neutrality of the energy sector by 2050.

The use of renewable energy sources is one of the most important areas of Ukraine's energy policy aimed at saving traditional fuel and energy resources, improving the state of the environment, and preventing climate change. Increasing the share of renewable sources in Ukraine's energy balance will contribute to the decarbonization process of the economy, necessary for the fulfillment of Ukraine's international obligations to reduce greenhouse gas emissions, and to reduce the consequences of the introduction of the Carbon Border Adjustment Mechanism (CBAM) by the European Union.

Increasing the share of energy carriers obtained from renewable sources will contribute to ensuring energy security and achieving energy independence of the state by diversifying energy sources.

Policies and measures under the dimension "decarbonization" are presented in detail in section 3.1. of this Plan.

Energy efficiency

The ESU defines self-sufficiency and consumption efficiency as the primary strategic goal. The main document establishing the legal framework of policy in the field of energy efficiency improvement is the Law of Ukraine "On Energy Efficiency"³⁵. The ESU defines self-sufficiency and consumption efficiency as the primary strategic goal. This law transposes into national legislation most of the provisions of Directive 2012/27/EU of the European Parliament and of the Council of October 25, 2012 on energy efficiency, amending Directives 2009/125/EU and 2010/30/EU and repealing Directives 2004/8/EU and 2006/32/EC (Directive 2012/27/EC). The Law of Ukraine "On Energy Efficiency" defines the legal, economic and organizational foundations of relations arising in the field of increasing energy efficiency during production, transportation, transmission, distribution, supply and consumption of energy. This regulatory act provides for giving priority to energy-efficient measures that reduce the demand for energy in the development of regulatory and legal acts, strategic documents of state policy and decision-making regarding the financing of measures for the development of the unified energy system of Ukraine, gas infrastructure objects or facilities in the field of heat supply, if energy-efficient measures are more economically expedient ("energy efficiency first" principle).

Certain provisions of Directive 2012/27/EU are implemented in Ukrainian legislation by special laws. For example, the issues of commercial accounting of thermal energy and water are regulated by the Law of Ukraine "On Commercial Accounting of Thermal Energy and Water Supply"³⁶. State financing of energy efficiency measures in the housing sector is carried out by the Energy Efficiency Fund, which operates in accordance with the Law of Ukraine "On the Energy Efficiency Fund"³⁷.

Directive 2010/31/EU of the European Parliament and Council of May 19, 2010 on the energy performance of buildings (Directive 2010/31/EU) was transposed by the Law of Ukraine "On Energy Efficiency of Buildings"³⁸. This law provides for the establishment of minimum requirements for the energy efficiency of buildings, conducting energy certification of buildings and surveying engineering systems, certification of energy auditors of buildings.

In December 2023, the Government approved the Long-Term Strategy for Thermal Modernization of Buildings for the Period Until 2050 by Order of the Cabinet of Ministers of Ukraine of December 29, 2023 No. 1228 "Some Issues of Strategic Development of Energy Efficiency of Buildings" (Official Gazette of Ukraine, 2024 p., No. 13, Art. 843).³⁹

³⁵ <https://zakon.rada.gov.ua/laws/show/1818-20#Text>

³⁶ <https://zakon.rada.gov.ua/laws/show/2119-19#Text>

³⁷ <https://zakon.rada.gov.ua/laws/show/2095-19#Text>

³⁸ <https://zakon.rada.gov.ua/laws/show/2118-19#Text>

³⁹ <https://zakon.rada.gov.ua/laws/show/1228-2023-%D1%80#Text>

The Law of Ukraine "On the combined production of thermal and electricity (cogeneration) and the use of waste energy potential" regulates relations related to the specifics of production, transmission, distribution and supply of electric and thermal energy from cogeneration plants.

In order to fully fulfill Ukraine's obligations under the Association Agreement between Ukraine and the European Union and the Treaty establishing the Energy Community, Ukraine implements the requirements for energy labeling and eco-design of energy-consuming products in accordance with the EU legislation. Regulation of the European Parliament and Council (EU) 2017/1369 of July 4, 2017 setting a framework for energy labelling and repealing Directive 2010/30/EU was transposed into national legislation by the Technical Regulation on Energy Labeling of Energy-Consuming Products, as approved by Order No. 164, approved by Order of the Ministry of Energy of 04/27/2022 No.164 40, registered in the Ministry of Justice on June 9, 2022 No. 615/37951. Directive of the European Parliament and Council 2009/125/EU of October 21, 2009 establishing a framework for the setting of ecodesign requirements for energy-related products was transposed by the Technical Regulation on establishing the system for determining eco-design requirements for energy-consuming products, as approved by resolution of the Cabinet of Ministers of Ukraine of October 3, 2018 No. 804 (Official Gazette of Ukraine, 2018 p., No. 80, Article 2678). ⁴¹ 25 technical regulations establishing requirements for eco-design of certain groups of energy consuming goods and 15 technical regulations on energy labeling are in force.

The main barriers to the implementation of energy efficiency measures are the distortion of the tariff policy, the lack of qualified personnel for the identification and implementation of projects, limited opportunities to attract financing and the high cost of the funds involved, the lack of sustainable state co-financing of energy efficiency measures.

Energy security

The key documents defining both goals and policies in terms of deepening the diversification of sources and ways of supplying energy resources from third countries with the potential goal of reducing dependence on the import of energy resources are NES ⁴² and ESU ⁴³. The first defines the general goal in the form of ensuring the diversification of energy supplies at the level of no more than 30% from one supplier, the second is a key strategy for diversification, stimulation of own production and development of further elements of added value (in particular, oil and gas processing). It should be noted that the ESU - setting the goal of comprehensive integration with the EU energy markets and ensuring the effective functioning of internal energy markets - defines the construction of an export-oriented energy industry as one of the indicators.

The National Security Strategy ⁴⁴ declares the need to diversify the sources and routes of the supply of energy resources among the goals. The energy security strategy envisages among the priority tasks the stimulation of import substitution, in particular through the development of bioenergy, wind energy, and the justified increase in the production of energy resources. The Concept of the state target economic program (with a planning horizon until 2026) and the program itself (for the period until 2028) were developed specifically for the nuclear industrial complex.

⁴⁰ <https://zakon.rada.gov.ua/laws/show/z0615-22#Text>

⁴¹ <https://zakon.rada.gov.ua/laws/show/804-2018-%D0%BF#Text>

⁴² <https://zakon.rada.gov.ua/laws/show/179-2021-%D0%BF>

⁴³ <https://zakon.rada.gov.ua/laws/show/373-2023-%D1%80#Text>

⁴⁴ <https://zakon.rada.gov.ua/laws/show/392/2020#Text>

As for increasing the flexibility of the national energy system, the above-mentioned strategies include, in order to ensure the balance reliability of the UES of Ukraine and support the further integration of RES, the introduction of highly maneuverable capacities.

In the issue of eliminating restrictions or interruptions in the supply of energy resources in order to increase the stability of energy systems, the main policies and measures include the ESU, the Law of Ukraine "On Critical Infrastructure" ⁴⁵, the Cybersecurity Strategy of Ukraine ⁴⁶, the Law of Ukraine "On the Basic Principles of Ensuring Cybersecurity of Ukraine" ⁴⁷, separate decisions RNBOU. The target indicator is the provision of physical, engineering and cyber protection of 100% of objects. It is stipulated separately that in the conditions of a full-scale invasion of the Russian Federation into Ukraine, the priority is the protection of critical infrastructure facilities (CIPs).

The Laws of Ukraine "On the electricity Market" ⁴⁸, "On the Natural Gas Market" ⁴⁹, and the corresponding subordinate legal acts regulate measures to ensure the security of supply, in particular, the responsibility of the Ministry of Energy to approve the rules on the security of natural gas and electricity supply and the National Action Plan, which are mandatory for all subjects of the relevant markets, as well as to monitor the security of supply (for electricity – together with the Regulator, the transmission system operator and other relevant institutions).

Another group of policies is the formation and maintenance of reserves of the main fuel energy resources: natural gas, coal, oil and petroleum products. Most of them are regulated at the level of legislation. At the end of 2022, amendments to the Law of Ukraine "On the Natural Gas Market" defined the obligation of the Ministry of Energy to calculate the target level of gas storage filling and to form a gas storage filling schedule. In 2023, the Law of Ukraine "On Minimum Reserves of Oil and Oil Products" ⁵⁰ was adopted, which provides for the creation of reserves for 90 days of net imports or 61 days of domestic consumption. The creation and maintenance of the minimum necessary reserves of coal and reserve fuel (fuel oil) is regulated by the Procedure for the formation of the forecast balance of electricity of the UES of Ukraine ⁵¹ and the Rules on the safety of electricity supply ⁵².

Energy market (electricity)

Policies and measures implemented by Ukraine in terms of market development are determined by such key priorities as further liberalization of the electricity market and deepening the integration of power systems and markets of Ukraine and EU countries. In terms of integration, Ukraine seeks to strengthen cross-border electricity connections with ENTSO-E countries by implementing projects of common interest. In particular, the ESU defines the goal of developing interconnectors and achieving the level of 6 GW of capacity with the ENTSO-E countries by 2032.

The expansion of cross-border infrastructure in combination with the integration of spot and balancing electricity markets will improve the competitiveness and liquidity of the domestic market due to

⁴⁵ <https://zakon.rada.gov.ua/laws/show/1882-20>

⁴⁶ <https://zakon.rada.gov.ua/laws/show/447/2021#Text>

⁴⁷ <https://zakon.rada.gov.ua/laws/show/2163-19>

⁴⁸ <https://zakon.rada.gov.ua/laws/show/2019-19#Text>

⁴⁹ <https://zakon.rada.gov.ua/laws/show/329-19#Text>

⁵⁰ <https://zakon.rada.gov.ua/laws/show/3484-IX#Text>

⁵¹ <https://zakon.rada.gov.ua/laws/show/z1312-18#Text>

⁵² <https://zakon.rada.gov.ua/laws/show/z1076-18#n17>

activation of international electricity trade, will create better conditions for attracting systematic investments in the sector development and the introduction of new energy technologies.

Ukraine implements European rules of international electricity trade through the use of joint auctions for the distribution of available capacity of cross-border networks, including the organization of auctions on the European auction platform Joint Allocation Office (JAO). The next stage of integration is a full-fledged coupling of the electricity spot markets (day-ahead market and intraday market), which involves the use of implicit auctions for the allocation of interconnectors' capacity and joint pricing on the coupled markets.

The transformation of the market will take place in the direction of a balanced combination of the advantages of "large" and local "small" energy. The priority is the development of distributed generation based on RES in combination with flexible energy capacities and technologies to ensure resource adequacy, flexibility, operational safety and stability of the power system and market. In the country's electricity balance by 2030, Ukraine aims to achieve at least 25% of electricity produced from RES.

To increase the stability of the power system and the market competitiveness, Ukraine implements policies for the development of distributed generation (primarily based on RES and energy storage installations) and smart grids. These policies provide for a more active participation of consumers in the market and the use of new market models - the mechanism of self-production (self-consumption), aggregation, demand-side management, energy cooperatives, etc.

The development of smart grids should take place within the framework of the 2035 Concept of the implementation of smart grids in Ukraine.⁵³ Electricity distribution system operators (DSOs) within the framework of five-year distribution system development plans develop measures for digitalization of networks and include relevant projects in their annual investment programs, which are subject to approval by the Regulator.⁵⁴ Financing of the programs takes place within the framework of tariffs for electricity distribution, which for the vast majority of DSOs are applied on the principles of incentive regulation (RAB-tariffs).⁵⁵

In 2019, Ukraine carried out a radical reform of the wholesale and retail electricity markets, moving from the "single buyer" to a competitive EU market model by introducing the appropriate institutional environment and structural organization of the market, provided for by the provisions of the Third EU Energy Package. Currently, Ukraine is working on creating an institutional environment for the implementation of the Fourth EU Energy Package (Clean Energy Package). Additionally, basic policies and measures regarding the development of the electricity market include:

- ensuring the proper market functioning through its liberalization in combination with temporary regulatory interventions aimed at stabilizing the market at the stage of immaturity of the competitive environment and limited integration with the markets of the EU and ENTSO-E countries;
- Development of exchange trading, introduction of market pricing in all market segments, in particular, application of real-time prices, gradual rejection of cross-subsidization.

⁵³ <https://zakon.rada.gov.ua/laws/show/908-2022-%D1%80#Text>

⁵⁴ <https://zakon.rada.gov.ua/laws/show/v0955874-18#n11>

⁵⁵ <https://zakon.rada.gov.ua/laws/show/v1175874-18#n15>

- Deepening the market integration of RES producers by ensuring their participation in organized market segments and direct electricity trade, taking into account responsibility for imbalances.
- Ensuring the protection of vulnerable consumers through direct monetized subsidies, preferential prices provided by imposing public service obligations (PSO) on individual market participants.

In order to introduce market-based pricing, there will be a gradual approximation of electricity prices for households to a market-based level with concurrent protection of vulnerable consumers and boosting competition in the retail market. The protection of energy-poor consumers will take place through targeted support and incentives to improve energy efficiency.

Energy market (gas)

According to NES, ESU, taking into account the requirements of the Law of Ukraine "On the Natural Gas Market", other laws, as well as Ukraine's international obligations, the development of the oil and gas infrastructure is aimed at achieving the following goals:

- Ensuring sufficient connections with the EU/Energy Community for the export/import of natural gas, as well as the development of oil transport system connections;
- Modernization taking into account requirements for increasing energy efficiency and reducing emissions of harmful substances and optimizing oil and gas infrastructure facilities;
- Prospective repurposing of individual objects of the oil and gas infrastructure to new types of activities within the framework of decarbonization.

Accordingly, the main policies and measures aimed at achieving these goals relate to promoting the development of new interconnections, improving energy infrastructure planning procedures and establishing its involvement in future EU energy markets, optimizing the existing oil and gas infrastructure, and building a regulatory and legal framework for new energy markets.

In terms of the integration of natural gas, renewable and low-carbon gas markets, the main goals relate to integration with the EU energy markets, biomethane production and natural gas extraction, ensuring the completeness and reliability of gas accounting, as well as the introduction of market-based pricing of energy resources for all consumers while simultaneously protecting those who need state support. Accordingly, among the main policies and measures aimed at achieving these goals, it is worth highlighting:

- Ensuring the possibility of gas export, both of natural gas and biomethane;
- Solving technical issues of gas quality supplied to gas networks, as well as safety issues;
- Implementation of accounting in energy units;
- Ensuring effective management of GDSOs;
- Increasing the efficiency of the functioning of the gas balancing system;
- Provision of 100% metering;
- Creation of a functioning commercial gas accounting system.

These policies and measures are described in more detail in section 3 of this Plan.

In the aspect of reducing energy poverty, the task consists in the legislative definition of this concept, the definition of the methodology for calculating a specific circle of people in a state of energy poverty, and the definition of a clear list of measures to reduce energy poverty in Ukraine. At the same time, the existing system of direct subsidies should be strengthened, taking into account the goals of liberalizing prices for energy resources for all categories of consumers.

iii. Key issues of cross-border relevance

1) Separate issues of financing new capacities with the involvement of the EU:

- **Financing of gas and oil projects:**

The new TEN-E Regulation no longer provides for the financing of natural gas and oil projects from the funds of the Connecting Europe Facility (CEF). At the same time, both this NECP and the NECP of the EU member states indicate that the need for the use of natural gas and oil will not completely cease until 2030, and in order to avoid supply interruptions, construction or other additional measures for oil and gas infrastructure are necessary. Relevant projects are described in section 3.

Accordingly, the financing mechanisms of such projects which are necessary from the point of view of security of supply and livelihood of the population and the economy should be agreed upon.

- **Funding of hydrogen projects:**

In March 2023, the European Commission provided details of the creation of the European Hydrogen Bank, the idea of which was announced back in September 2022⁵⁶. The proposed activities of this financial mechanism include the provision of financing in the form of a "green" premium distributed in auctions, including for hydrogen producers outside the EU. In August 2023, the European Commission published the terms of the first auction, which, however, only applies to future hydrogen producers within the European Economic Area (not including Ukraine)⁵⁷. It is assumed that the platform of the H2Global project will be used to conduct support auctions for the import of hydrogen to the EU.

In this connection, it is expedient to involve the Ukrainian side in preparing the terms of future auctions, in particular with the aim of ensuring non-discriminatory participation of Ukrainian companies in future tenders.

2) Main issues related to infrastructure projects of other states (natural gas):

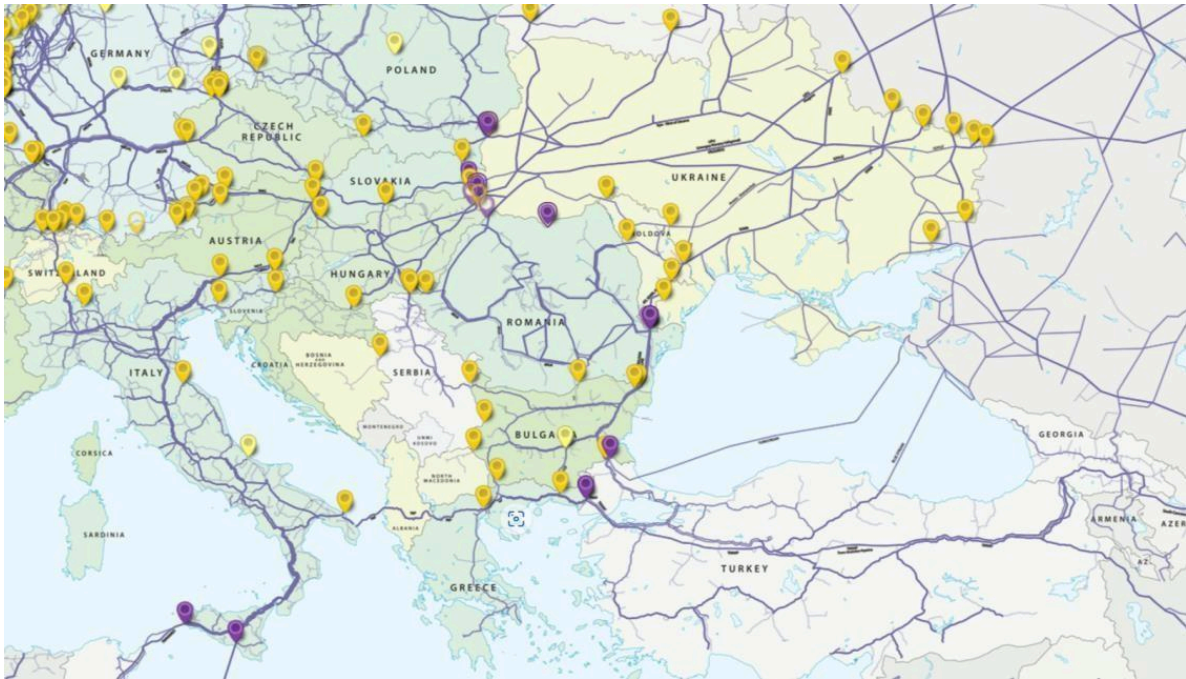
After the adoption of the RePowerEU plan which fixed the gradual abandonment of Russian gas as soon as possible and preferably by 2027, the map of gas flows and gas infrastructure began to change radically. Moreover, in the period 2025-2030, transit of natural gas through the territory of Ukraine from the Russian Federation to the EU and the Energy Community is not expected⁵⁸. Regarding the development of natural gas infrastructure, Ukraine is significantly dependent on the infrastructure projects of other countries.

⁵⁶ COM/2023/156 final

⁵⁷ https://climate.ec.europa.eu/system/files/2023-08/innovationfund_pilotauktion_termsandconditions_en.pdf

⁵⁸

<https://www.radiosvoboda.org/a/news-halushchenko-ukraina-rosiia-prodovzhennia-tranzytu-hazu/32552079.html>



Source: *ENTSOG Transparency Platform*

In general, it is possible to distinguish several directions in which the development of important projects for Ukraine (both necessary and alternative) is taking place:

1. Corridor: Turkey-Greece-Bulgaria-Romania-Hungary-Slovakia;
2. Corridor: Germany-Poland;
3. Corridor: Italy-Austria-Slovakia.

Regarding the Turkey-Greece-Bulgaria-Romania-Hungary-Slovakia corridor:

Since the independence day, natural gas moving in transit through Ukraine was delivered to consumers in Hungary, Slovakia, as well as Romania, Bulgaria, and through it to Greece, Serbia and Turkey. With the construction of the BlueStream (2005) and TurkStream (2019) gas pipelines, gas from the Russian Federation is transported directly to Turkey. Taking into account the cessation of transit through the territory of Ukraine from 2025, according to the most current information on this corridor, a radical change in gas flows from the south to the north is expected due to a significant increase in regasification capacities, as well as an increase in the possibility of receiving additional volumes of gas from other sources. At the same time, new gas production in Turkey will most likely be used to cover the country's own growing needs.

Thus, by the end of 2024, the total volume of regasification capacity of Greece should reach 25.7 billion m³/year, which is 5 times higher than the current volume of consumption of this country. Also, the TAP gas pipeline passes through Greece, the capacity of which is proposed to be increased to 20 billion m³/year. In addition, the construction of the new EastMed and Poseidon projects is proposed on the territory of Greece: the first one should connect new sources of gas supply to the EU from Cyprus and the Middle East; the second will provide an underwater connection between Greece and Italy. Both new projects are included in TYNDP 2022 with an initial commissioning date of 2025 (final commissioning for the Poseidon project is expected by 2028; however, due to a number of political reasons, the projects may take longer to implement). EastMed project is

included in the list of PCI/PMI projects under number 15.2.⁵⁹ The capacity of the projects is initially 11-12 billion m³ with the possibility of increasing to 20 billion m³/year.

To the north, Greece connects with Bulgaria at two junctions. On one of them, the IGB gas pipeline with a capacity of 3 billion m³/year⁶⁰ began operating in October 2022 (with the possibility of expansion to 5 billion m³/year, which, according to Bulgartransgaz, is expected from 2025). The option of expanding the capacity of another point of the Kulata/Sidirokastron IP is also being considered (according to Bulgartransgaz, it is expected from 2026); for this purpose, it is also necessary to strengthen the GTS of Bulgaria (currently, the corresponding project TRA-N-1140 is included in ENTSG TYNDP 2022 with a deadline of 2025).

Like Greece, Bulgaria expects to increase its role as a gas transit country. In particular, the gas coming to Bulgaria from Greece and Turkey will be transported to Serbia,⁶⁰ Romania, and through them to other countries. In addition to Greece, gas to Bulgaria can also enter directly through the territory of Turkey thanks to a recently concluded contract with the Turkish state company BOTAS. The terms of this agreement are confidential; however, according to available information, it should allow the Bulgarian side to gain access to regasification capacity in Turkey in the amount of 1.5 billion m³/year; BOTAS should deliver this volume to the border with Bulgaria. Considering the insignificant volume of gas consumption by Bulgaria (even with the prospect of increase), the available gas resource will exceed its needs, and therefore is intended for transit to other countries via Serbia or Romania. The latter covers about 70% of its own needs at the expense of its own production, which is planned to be gradually increased, so at the exit from Romania we can expect significant volumes of gas for transportation to other countries. Bulgaria is connected to Romania by gas pipelines that were primarily used for the transit of gas from Russia (Kardam/Negru Voda 1, 2, 3); by 2026, it is planned to carry out work on the strengthening of the Bulgarian GTS to increase the possibility of gas movement to Romania in the volume of 4.7 billion m³/year (the project is included in ENTSG TYNDP 2022, TRA-N-1124).

In accordance with the NES, full technical, institutional and legislative integration into European gas transportation networks should be ensured, cooperation with the countries of North-Western, Southern Europe and other regions should be developed regarding the joint implementation of gas supply diversification projects to Central-Eastern Europe. In this context, in January 2024, Ukraine and Moldova joined the Memorandum on the Vertical Corridor, which provides for coordination at the level of operators with the participation of operators from Greece, Bulgaria, Romania, Hungary and Slovakia, with the aim of ensuring the movement of gas from the south to the north of Europe (with the help of capacities of the Trans-Balkan gas pipeline).⁶¹

Regarding the Germany-Poland corridor:

Since the independence day, natural gas transiting through Ukraine has been delivered to consumers in Poland and Germany through Ukraine. After the launch of the Yamal (2006) and Nord Stream (2011) gas pipelines, gas from the Russian Federation began to be supplied to these countries directly. At the same time, as part of the hybrid aggression of the Russian Federation, the volume of gas transportation through the territory of Ukraine and Poland was reduced.

⁵⁹ Commission Delegated Regulation (EU) amending Regulation (EU) No 2022/869 of the European Parliament and of the Council as regards the Union list of projects of common interest and projects of mutual interest, 28.11.2023, C(2023) 7930 final .

⁶⁰ In December 2023, a gas pipeline between Bulgaria and Serbia was put into operation, allowing a bidirectional flow of gas in the volume of 1.8 billion m³/year (in case of increasing the capacity of the Bulgarian GTS, it is possible to expand the capacity of this gas pipeline to 2.4 billion m³/year).

⁶¹ [Співпраця щодо Вертикального коридору посилюється завдяки підписанню Меморандуму про взаєморозуміння щодо участі Молдови, Словаччини та України - Оператор ГТС України \(tsoua.com\)](https://tsoua.com)

Taking into account the cessation of transit through the territory of Ukraine at the end of 2024, according to the most current information, a steadily large volume of gas is expected to arrive along this corridor (taking into account Germany's significant domestic needs) due to an increase in capacity regasification in Germany and Poland, which increases the potential of gas movement from north to south. Thus, according to the Ministry of Economy and Climate Protection of Germany, in 2025-2030 the capacity of all LNG terminals in Germany will increase from 37 billion m³ to 54 billion m³ ⁶².

On the part of Poland, 2 projects are planned: one – to expand the regasification capacity of the LNG terminal in Świnoujście from the current 6.2 to 7.5 billion m³; the second - regarding the launch of the FSRU near Gdansk by 2027. Both projects are included in TYNDP 2022 (LNG-F-272; LNG-A-947).

It is important for Ukraine to ensure a sufficient connection between the north and the south of Poland in order to obtain an additional source of supply and export of gas. At the same time, historically the GTS of Poland had problems with ensuring the movement of gas from north to south (in this regard, the TRA-F-245 project is included in TYNDP 2022 with an expected final implementation date of 2028).

Regarding the Italy-Austria-Slovakia corridor:

Since the independence day, natural gas moving in transit through Ukraine was also delivered to consumers in Austria and Italy. Taking into account the termination of transit through the territory of Ukraine at the end of 2024, according to the most current information on this corridor, a radical change in flows from the south to the north is expected, which will strengthen the role of Italy as a gas transit country between Africa and the Middle East and Europe.

In 2022-2023, Italy significantly increased its regasification capacity, but these projects did not completely eliminate its dependence on Russia. By 2025, this demand is expected to be covered by new domestic production, piped and liquefied natural gas inflows, as well as energy savings and the substitution of natural gas with biomethane. For this, it is necessary, in particular, to strengthen the internal network of Italy through the implementation of the Linea Adriatica project. Gas exports to Austria can currently take place only through the Tarvisio/Arnoldstein IP. Particular attention should be paid to the needs of Austria, which still needs to strengthen its own measures to cut off Russian gas. It is possible to use the Trans-Balkan gas pipeline (within the "Vertical Corridor") to provide Austria's needs for additional gas volumes, including using the additional advantages of Ukrainian gas pipelines.

3) Main issues related to infrastructure projects of other states (hydrogen):

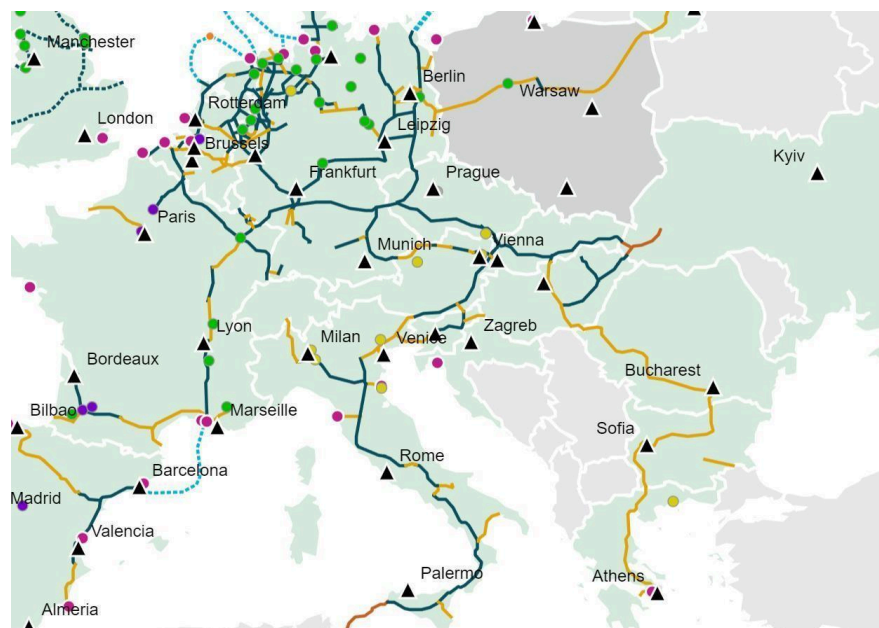
In general, significant volumes of transboundary hydrogen transportation are not expected until 2030. At the same time, after 2030, both the EU and individual member states predict the arrival of this resource through imports from other states. Ukraine is competing for this opportunity with the countries of North Africa and the Middle East.

⁶² BMWK, Bericht des Bundeswirtschafts- und Klimaschutzministeriums zu Planungen und Kapazitäten der schwimmenden und festen Flüssigerdgasterminals, 03.03.2023, <https://www.bmwk.de/Redaktion/DE/Downloads/Energie/20230303-Lng-bericht.pdf?blob=publicationFile&v=2>.



Source: European Hydrogen Alliance with reference to the European Commission

In order to deliver hydrogen to the EU and transport it to consumers, it will be necessary to provide the appropriate infrastructure. The Central European Hydrogen Corridor project (CEHC for short), whose participant is "GTS Operator of Ukraine" LLC, is reflected in the regional gas investment plan of North-Western Europe from December 2022⁶³ and in the vision of the development of hydrogen networks developed by the European Hydrogen Backbone (EHB) initiative, of which as of April 2022 "GTS Operator of Ukraine" LLC is also a partner⁶⁴.



Source: European Hydrogen Backbone Maps

⁶³ https://www.eugastsogrip.eu/wp-content/uploads/2022/12/entsog_GRIP_NW_2022_221208.pdf

⁶⁴ <https://ehb.eu/#partners>

In addition, planning processes for future hydrogen infrastructure are taking place within ENTSOG, in particular during the preparation of TYNDP (which currently covers hydrogen projects)⁶⁵. It should be taken into account that inclusion in TYNDP opens way to receive grants from the Connecting Europe Facility, for which Ukraine has also been competing since recently.⁶⁶



Source: ENTSOG TYNDP 2022 Map

From the analysis of TYNDP 2022, it can be seen that operators of other countries near Ukraine envisage the creation of hydrogen infrastructure up to the borders with Ukraine:

- HYD-N-1165 "HU hydrogen corridor HU/UA", connection with Hungary (Beregdaros - Beregovo);
- HYD-N-730 "Coroi – Medieșu Aurit modernization for H2 transmission", connection with Romania (Tekovo);
- HYD-N-640 "Isaccea – Jupa modernization for H2 transmission", connection with Romania (Orlovka);
- HYD-N-756 "Negru Voda – Isaccea modernization for H2 transmission", connection with Romania (Orlovka) (it concerns the Trans-Balkan gas pipeline).

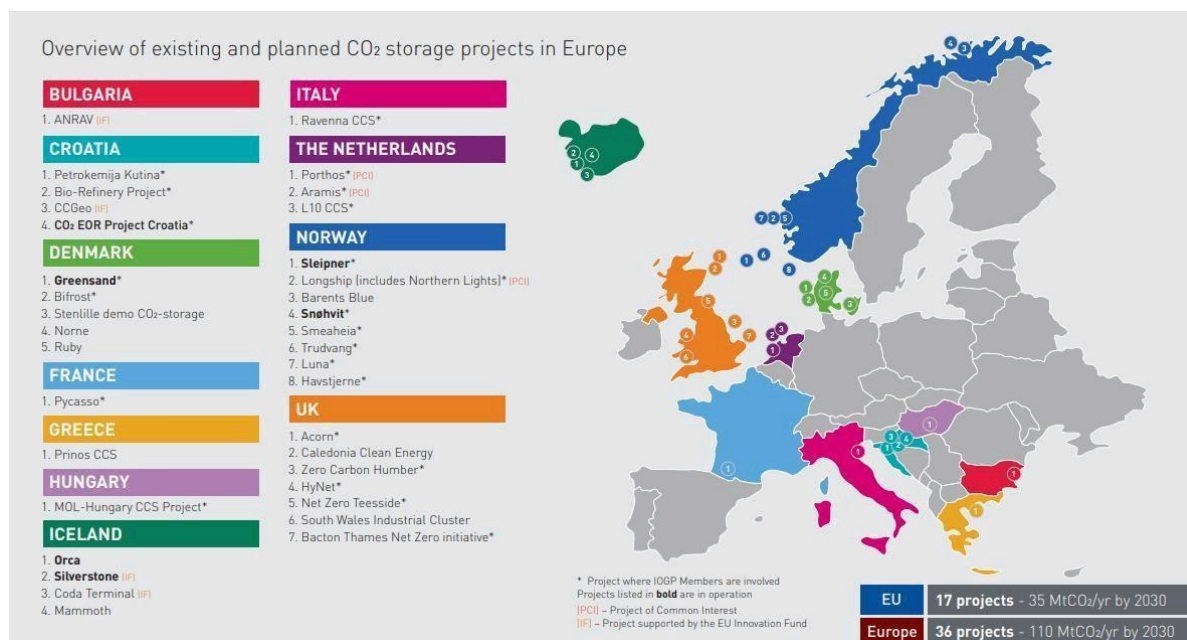
At the same time, these projects are not included in the latest list of PCI/PMI projects approved by the European Commission at the end of 2023. In addition, during the consultations on the project of this NECP, Poland expressed intentions to build cross-border hydrogen infrastructure (although the corresponding projects are not yet in TYNDP 2022 and in the list of PCI/PMI projects of the European Commission).

4) The main issues related to infrastructure projects of other countries (carbon dioxide, hereinafter - CO2):

⁶⁵ ACER, Opinion No.06/2023 of 14 July 2023 on the ENTSOG draft Ten-Year Network Development Plan 2022, para 26.

⁶⁶ https://ec.europa.eu/commission/presscorner/detail/en/ip_23_3061

At the EU level, the goal of achieving CO₂ storage capacity of 50 million tons by 2030 is being considered. As of December 2023, 22 projects related to CO₂ capture, storage and use technologies (hereinafter - CCUS) are being developed within the scope of the EU Innovation Fund ⁶⁷. In addition, the latest decision of the European Commission included 14 CCUS projects in the list of PCI/PMI projects ⁶⁸. These projects form part of the picture of CCUS projects in Europe.



Source: IOGP ⁶⁹

On February 6, 2024, the European Commission adopted the Strategy for the Industrial Carbon Management,⁷⁰ which defines not only the potential for the contribution of these technologies to reducing emissions but also future measures for the development of pan-European infrastructure. According to this strategy, the recognition of CO₂ storage facilities outside the EU is possible in the presence of an ETS synchronized with the EU or under the conditions of safe and ecological storage of CO₂ which leads to a reduction in emissions.

iv. Administrative structure of implementing national energy and climate policies

In order to implement NECP, including monitoring the implementation of policies and measures, preparation of integrated national reports on progress in the field of energy and climate, by the end of October 2024 the Cabinet of Ministers of Ukraine will adopt a separate decision that will determine the framework conditions for such monitoring and implementation, as well as the procedure for interdepartmental interaction. This decision will include a description of the roles of the central executive authorities of Ukraine, the Secretariat of the Energy Community and relevant stakeholders.

⁶⁷ https://climate.ec.europa.eu/eu-action/eu-funding-climate-action/innovation-fund/innovation-fund-projects_en

⁶⁸ Commission Delegated Regulation (EU) amending Regulation (EU) No 2022/869 of the European Parliament and of the Council as regards the Union list of projects of common interest and projects of mutual interest, 28.11.2023, C(2023) 7930 final .

⁶⁹ <https://iogpeurope.org/wp-content/uploads/2023/10/Map-CO2-Storage-Projects-in-Europe.pdf>

⁷⁰ [EUR-Lex - 52024DC0062 - EN - EUR-Lex \(europa.eu\)](https://eur-lex.europa.eu/lexuris/ui/52024DC0062)

The relevant authorities for the implementation of policies in the field of energy and climate have the following authorities:

- The President of Ukraine (in terms of exercising constitutional powers to ensure national security, implementing the state's strategic course towards full membership of Ukraine in the EU and NATO);
- The Verkhovna Rada of Ukraine (in terms of adopting laws, the state budget, approving national programs of economic, scientific and technical development, environmental protection);
- The Cabinet of Ministers of Ukraine (as the highest body in the system of executive authorities that directs and coordinates the work of ministries and other executive authorities);
- Ministry of Economy;
- Ministry of Energy;
- Ministry of Environment;
- Ministry of Infrastructure;
- NEURC;
- State Energy Efficiency, State Geological Survey, State Energy Inspection, other central bodies of executive power;
- Operators of infrastructure facilities and individual subjects of energy markets;
- Local self-government bodies (hereinafter referred to as LGUs).

The Ministry of Economy is the central body of the executive power, whose activities are directed and coordinated by the Cabinet of Ministers of Ukraine, and which ensures the setting and implementation of the state policy of economic, social development and trade, state policy in the field of technical regulation, state investment policy, state innovation policy in the real sector of the economy, state foreign economic policy, state policy in the field of entrepreneurship development, public-private partnership, state policy in the field of labor and population employment, setting of state policy in the field of consumer rights protection, state policy on price control, state regulatory policy and state licensing policy, permit system, supervision (control) in the field of economic activity⁷¹.

The Ministry of Economy participates in the setting and implementation of state policy in the field of public procurement, including playing an important role in the implementation of energy-efficient procurement. The powers of the Ministry of Economy include the determination of permissible energy efficiency classes for the purchase of energy-consuming products.

Among other things, the Ministry of Economy plays a key role in coordinating work on bringing the national system of technical regulation and national standardization into compliance with EU legislation and European and international standards. The Ministry of Economy also analyzes the state of competitiveness and resource efficiency of industries, develops and coordinates the implementation of measures to increase their level.

The Ministry of Energy is the central body of the executive power, whose activities are directed and coordinated by the Cabinet of Ministers of Ukraine, and which ensures the formation and implementation of state policy in the electric power, nuclear industry, coal industry, peat mining, oil and gas and oil and gas processing complex, formation and implementation

⁷¹ <https://zakon.rada.gov.ua/laws/show/459-2014-%D0%BF#Text>

of state policy in the field of renewable energy sources and alternative types of gas fuel and in the field of supervision (control) in the fields of electricity and heat supply, as well as in the natural gas market.⁷²

It is worth noting that the Cabinet of Ministers of Ukraine and the Ministry of Energy also exercise the rights of the state as the owner of individual subjects of the natural gas and electricity markets, as well as individual objects of the gas and electricity infrastructure, in particular the gas transportation system (GTS) and the electricity transmission system, gas distribution systems (GDS) and electricity distribution systems, underground gas storage facilities.

The Ministry of Environment is the central body of the executive power, whose activities are directed and coordinated by the Cabinet of Ministers of Ukraine, and which ensures the setting and implementation of state policy in the field of environmental protection, state policy in the field of forestry and hunting, and the setting of the state policy in the field of geological study and rational use of natural resources, regarding the implementation of state supervision (control) in the field of environmental protection, rational use, reproduction and protection of natural resources⁷³.

It should be noted that there is currently no framework legislation in Ukraine that defines the role and powers of state bodies on climate change issues. However, the draft Law of Ukraine "On the Basic Principles of State Climate Policy" (Reg. No. 11310 of May 31, 2024) should resolve this. At the moment, the main functions are assigned to the Ministry of Environment while some functions are assigned to other central government bodies. Among other things, the Ministry of Environment ensures the setting and implementation of state policy in the area of regulation of ozone-depleting substances and fluorinated greenhouse gases, protection of the ozone layer and prevention of the increase in the level of global warming, climate change and the fulfillment of the requirements of the UN Framework Convention on Climate Change, the Kyoto Protocol to it and the Paris Agreement. Other bodies related to climate policy are the Ministry of Energy, the Ministry of Agrarian Policy, the State Emergency Service⁷⁴. Thus, the Government's plans to create an effective **climate governance architecture** (as a system of principles, rules, and processes for the setting and implementation of climate policy) require a clear division of functions and powers of state bodies, which is provided for by the draft Law of Ukraine "On the Basic Principles of State Climate Policy."

The State Geological Survey is the central body of the executive power, whose activities are directed and coordinated by the Cabinet of Ministers of Ukraine through the Minister of Environmental Protection and Natural Resources, and which implements state policy in the field of geological study and rational use of subsoil, is the authorized body for the implementation of production sharing agreements⁷⁵.

NEURC is a permanent collegial central body of executive power with a special status that carries out state regulation, monitoring and control over the activities of business entities in the fields of energy and communal services⁷⁶. The main tasks of the Regulator are:

1. ensuring the effective functioning and development of markets in the fields of energy and communal services;
2. promoting the effective opening of energy and utility markets for all consumers and suppliers and ensuring non-discriminatory user access to networks/pipelines;

⁷² <https://zakon.rada.gov.ua/laws/show/507-2020-%D0%BF>

⁷³ <https://zakon.rada.gov.ua/laws/show/614-2020-%D0%BF#Text>

⁷⁴

<https://rac.org.ua/wp-content/uploads/2024/03/racse-climate-governance-architecture-ukraine-institutions-ukr.pdf>

⁷⁵ <https://zakon.rada.gov.ua/laws/show/1174-2015-%D0%BF#Text>

⁷⁶ <https://zakon.rada.gov.ua/laws/show/1540-19#Text>

3. promoting the integration of the electricity and natural gas markets of Ukraine with the relevant markets of other countries, in particular within the framework of the Energy Community, cooperation with the Council of Regulators of the Energy Community, the Secretariat of the Energy Community and national energy regulators of other countries;
4. ensuring the protection of the rights of consumers of goods, services in the fields of energy and communal services regarding the receipt of these goods and services of appropriate quality in sufficient quantity at reasonable prices;
5. promotion of cross-border trade in electricity and natural gas, ensuring investment attractiveness for infrastructure development;
6. implementation of price and tariff policy in the spheres of energy and communal services;
7. promoting the implementation of energy efficiency measures, increasing the share of energy production from renewable energy sources and environmental protection;
8. creation of favorable conditions for attracting investments in the development of markets in the spheres of energy and communal services;
9. promoting the development of competition in the energy and utility markets;
10. other tasks provided for by law ⁷⁷.

The Ministry of Infrastructure is the central body of the executive power, whose activities are directed and coordinated by the Cabinet of Ministers of Ukraine, and which ensures the formation and implementation of state policy in the field of road, railway, sea and inland water transport, air transport and the use of airspace of Ukraine, multimodal transportation, protection of critical infrastructure in the relevant sectors, in the field of state regional policy, development of local self-government, territorial organization of power and administrative-territorial system, housing policy, in the field of housing and communal services, household waste management, in the field of construction, urban planning, spatial planning of territories and architecture, in the field of restoration of regions, territories and infrastructure affected by the armed aggression of the Russian Federation, as well as in the field of effective use of fuel and energy resources, alternative types of liquid and solid fuel, energy conservation, ensuring energy efficiency ⁷⁸.

It is important to note the ratio of powers of NEURC and the Ministry of Infrastructure in regulating the field of heat supply. NEURC is responsible for state regulation, licensing and setting tariffs for business entities that produce thermal energy at thermal power plants, thermal power plants, nuclear power plants and cogeneration plants. At the same time, the Ministry of Infrastructure forms state policy in the field of heat supply. Licensing of thermal energy production at other types of installations, transportation and supply of thermal energy is carried out by regional and Kyiv city state (military) administrations, and tariffs are set by local government in accordance with the procedure determined by the Cabinet of Ministers of Ukraine ⁷⁹.

⁷⁷ <https://www.nerc.gov.ua/pro-NEURC/osnovni-zavdannya-ta-funksiyi>

⁷⁸ <https://zakon.rada.gov.ua/laws/show/460-2015-%D0%BF#Text>

⁷⁹ <https://zakon.rada.gov.ua/laws/show/869-2011-%D0%BF#Text>

The Ministry of Infrastructure, together with the Ministry of Energy and the NEURC, are key bodies that should operationalize the principle of "energy efficiency first" and ensure its end-to-end implementation.

The State Agency on Energy Efficiency and Energy Saving is the central body of the executive power, whose activities are directed and coordinated by the Cabinet of Ministers of Ukraine. The main tasks of the State Energy Efficiency Agency are the implementation of state policy in the field of effective use of fuel and energy resources, energy conservation and alternative types of fuel; ensuring an increase in the level of energy efficiency in all sectors of the national economy. State Energy Efficiency is responsible for the development and implementation of technical regulations based on relevant acts of EU legislation.

The Energy Efficiency Fund started its activities in July 2018⁸⁰. The purpose of the Fund is to support government initiatives on energy efficiency, the implementation of incentive tools and support for the implementation of energy efficiency measures, in particular in the housing sector in order to implement the Paris Agreement, the acquis of the European Union and the Treaty on the Establishment of the Energy Communities. **Municipalities** play an important role, in particular in the field of improving energy efficiency.

The State Inspectorate for Energy Supervision is a central body of executive power, whose activities are directed and coordinated by the Cabinet of Ministers of Ukraine through the Minister of Energy and which implements state policy in the field of supervision (control) in electricity and heat supply, as well as in the natural gas market. The main tasks of State Inspectorate for Energy Supervision are the implementation of state policy, the submission to the Minister of Energy of proposals to ensure the formation of state policy, as well as the organization and implementation of state policy in the field of supervision (control) in electricity and heat supply, as well as in the natural gas market⁸¹.

The natural gas market is operated by **the GTS operator** (GTS Operator of Ukraine LLC), which is responsible for the reliable and safe operation, maintenance and development of the state-owned GTS. GTSO is independent from other types of activities on the natural gas market and certified since 2020 according to the ISO model, as well as an observer member of ENTSOG. Natural gas storage is provided by **the gas storage operator** (Ukrtransgaz JSC). GSSO was certified in 2023 in accordance with the requirements of Regulation (EU) No. 715/2009 (as amended in 2022).

In the electricity market, the system-forming element is the **transmission system operator** (TSO) - NEC Ukrenergo, which is responsible for the development of the transmission system, including cross-border transmission lines. NEC Ukrenergo is a member of ENTSO-E and is certified as an TSO according to the ISO model. TSO also performs the functions of operational and technological control (dispatching) in the United Energy System (UES) of Ukraine, is the operator of the balancing market, the market of auxiliary services, the administrator of commercial accounting and the administrator of calculations, the operator of auctions for the distribution of capacity of interstate networks.

An operator of the day-ahead and intraday electricity markets is **Market Operator JSC**, which is responsible for the organization of electricity trading and financial settlements in these segments. To fulfill the functions of the **guaranteed buyer**, the SOE Guaranteed Buyer was created, which operates in three main directions: 1) purchase of electricity

⁸⁰ Acts on the basis of the Law of Ukraine "On the Energy Efficiency Fund":

<https://zakon.rada.gov.ua/laws/show/2095-19#Text>

⁸¹ <https://zakon.rada.gov.ua/laws/show/77-2018-%D0%BF#Text>

at the "green" tariff, 2) implementation of PSO mechanisms to ensure public interests in the electricity market (in terms of renewables development, provision of affordable electricity to the households and security of electricity supply during martial law) and 3) organization of auctions for entities of renewable generation.

The distribution of natural gas and electricity is carried out, respectively, **by gas distribution system operators** (GDSOs) and **electricity distribution system operators** (DSO), which are natural monopolies and are subject to regulation by the Regulator, in particular in terms of activity licensing and performance of licensing conditions, approval of system development plans and relevant investment programs, approval of tariffs for distribution services, quality control of service provision, etc.

Since the beginning of the full-scale invasion of the Russian Federation into Ukraine, significant changes have taken place in the management of these companies. In the spring of 2022, at the request of the State Bureau of Investigation,⁸² corporate rights of 26 GDSO were arrested and transferred to the National Agency of Ukraine for Identification, Search and Management of Assets Obtained from Corruption and Other Crimes (ARMA). By Order of the Cabinet of Ministers of Ukraine of May 28, 2022 No. 429 "Some issues of asset management subject to seizure in criminal proceedings, in exceptional cases" (Official Gazette of Ukraine, 2022 p., No. 45, Article 2474) in order to prevent risk emergence of an emergency situation in the energy sector the Cabinet of Ministers of Ukraine agreed to transfer to the management of the State Joint Stock Company "Chornomornaftogaz" seized stocks of shares "for the period until the risk of failure and/or interruption of the functioning of assets, which may lead to the emergence of emergency situations, and until the completion of procedural measures". At the same time, by the resolution of the Cabinet of Ministers of Ukraine of November 25, 2022 No. 1335 "On the settlement of the issue of the use of gas distribution systems or their components" (Official Gazette of Ukraine, 2022 p., No. 97, Article 6042), the proposal of the Ministry of Energy was approved to conclude contracts under the model provided by the Resolution of the Cabinet of Ministers of Ukraine of February 21, 2017 No. 95 "On ensuring the effective use of gas distribution systems or their components" (Official Gazette of Ukraine, 2017 p., No. 20, Article 559) with LLC "Gas Distribution Networks of Ukraine" as regards operation of gas distribution systems or their components and, in connection with this, termination of contracts for the operation of gas distribution systems or their components concluded with GDSO in accordance with the provisions of the said resolution. In this regard, Gas Distribution Networks of Ukraine LLC, which is part of the Naftogaz Group, received a license to carry out natural gas distribution activities in accordance with the resolution of the NEURC of December 26, 2022 No. 1839,⁸³ the territory of which is gradually increasing with the transfer of assets from previous GDSO.⁸⁴ At the same time, licenses of previous operators are suspended.⁸⁵ At the same time, court processes are ongoing, in which a complex of these decisions is challenged.

A major player in the natural gas market, which operates on the retail and wholesale markets, and also performs a number of special duties to ensure public interests, is **the Naftogaz Group**, which includes mining companies (JSC "Ukrgezvydobuvannya" and PJSC "Ukrnafta"), companies - suppliers (Gas Supply Company "Naftogaz of Ukraine" LLC, "Gas Supply Company "Naftogaz Trading" LLC, "Gas Supply Company "Naftogaz Teplo" LLC), as well as JSC "Naftogaz of Ukraine" as a wholesaler.

⁸² <https://dbr.gov.ua/news/dbr-peredalo-v-upravlinnya-armi-26-regionalnih-operatoriv-gazorozpodilchih-sistem>

⁸³

<https://www.nerc.gov.ua/acts/pro-vidachu-licenziyi-z-rozpodilu-prirodnogo-gazu-tov-gazorozpodilni-merezhi-ukrayini>

⁸⁴

<https://www.nerc.gov.ua/acts/pro-vnesennya-zmin-do-dodatka-do-postanovi-NEURC-vid-26-grudnya-2022-roku-1839-ta-vregulyuvannya-pitan-shchodo-provadjhennya-tov-gazorozpodilni-merezhi-ukrayini-diyalnosti-z-rozpodilu-prirodnoho-gazu>

⁸⁵ For example,

<https://www.nerc.gov.ua/acts/pro-zupinennya-diyi-licenziyi-z-rozpodilu-prirodnogo-gazu-vidanoyi-mikolayivgaz>

The Naftogaz Group also includes JSC "Ukrtransnafta", which is **the operator of main oil and petroleum product pipelines** based on a license for main oil transportation pipeline, as well as transportation of oil products through the main pipeline on the part of the main oil product pipeline "Samara - Western direction" (with the rights of the manager)⁸⁶. JSC "Ukrtransnafta" is the founder of "Naftogaz Oil Trading" LLC, which carries out wholesale fuel trade.

1.3. Consultations and involvement of national and Energy Community entities and their outcome

i. Involvement of the national parliament

On April 22, 2024, at a meeting of the Committee of the Verkhovna Rada of Ukraine on Environmental Policy and Nature Management with the participation of representatives of the Ministry of Economy and the Ministry of Environment, the NECP draft was presented, which received a positive assessment from those present and information about which was entered into the minutes of the committee meeting.

On May 29, 2024, the NECP draft was also presented at a meeting of the Committee of the Verkhovna Rada of Ukraine on Energy and Housing and Communal Services with the participation of representatives of the Ministry of Economy, whose members provided comments and decided to take note of information regarding the development of this strategic document.

ii. Involvement of local and regional authorities

On March 14, 2024, the draft NECP was presented to the Ministry of Economy as part of the hearings of the Congress of local and regional authorities under the President of Ukraine⁸⁷. About 1,100 participants (representatives of local self-government bodies, district, regional, Kyiv city state (military) administrations, all-Ukrainian associations) registered for the hearing, which is the highest rate of involvement of the Congress in 2024.

During the event, the participants drew attention to the importance of synchronizing the tasks of NECP with local development strategies, which will allow attracting funds from structural funds for the implementation of tasks for the development of the energy sector and climate protection. Also, representatives of local authorities emphasized that in the process of ensuring energy sustainability of Ukraine, it is worth paying attention to the process of decentralization and achieving energy autonomy of territorial communities. In addition, representatives of local self-government bodies were involved in public online consultations on the dimensions of NECP and on certain cross-sectoral issues (see below).

iii. Consultations of stakeholders, including the social partners, and engagement of civil society and the general public

The main assumptions for modeling the scenarios in the preparation of the NECP and the description of the main parameters of the modeling scenarios were agreed by the Ministry of Economy with the Ministry of Energy, the Ministry of Infrastructure, the Ministry of the Environment. This was preceded by consultations at the level of deputy ministers on the approach to modeling within the framework of the NECP.

During the development of NECP, the expert group carried out:

- working consultations with representatives of the Ministry of Environment on the issues of goals and policies under the dimension "decarbonization" (September 28, 2023), CBAM and carbon pricing tools (November 1, 2023), the status of the preparation of key documents for the "decarbonization" dimension (January 24, 2024.), decarbonization policies in the waste sector (January 23, 2024);

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<https://www.nerc.gov.ua/news/ukrtransnafta-otrimalo-licenziyu-z-transportuvannya-naftoproduktiv-magistralnim-truboprovodom>

⁸⁷

<https://www.congress.gov.ua/na-konhresovykh-slukhanniakh-obhovoryly-proiekt-natsionalnoho-planu-z-enerhetyky-ta-klimatu/>,
<https://www.kmu.gov.ua/news/ministerstvo-ekonomiky-ukrainy-prezentovalo-natsionalnyi-plan-z-enerhetyky-ta-klimatu-orhanam-mistsevoho-samovriaduvannia>

- working consultations with representatives of the Ministry of Infrastructure on issues of goals, adopted and planned policies in the direction of "energy efficiency" (September 28, 2023);
- working consultations with representatives of the Ministry of Energy on the issues of goals, policies and measures regarding renewable energy (in particular, the development of biofuels) and the development of the nuclear industrial complex (12.10.2023), future goals, policies and measures regarding hydrogen (15.12.2023), agreement on indicative indicators for the development of renewable energy sources (10.01.2024), policy in the coal mining sector (11.04.2024);
- working consultations with representatives of the Ministry of Agrarian Policy on the issues of forecasting GHG emissions and decarbonization policies in the agricultural sector (January 18, 2024, April 2, 2024);
- working consultations with infrastructure operators and the largest players of the respective markets, in particular JSC "Ukrgezvydobuvannya" (21.11.2023), JSC "Ukrtransnafta" (22.11.2023), JSC Ukrtransgaz (November 29, 2023), Ukrenergo NEC (November 30, 2023, May 20, 2024), GTS Operator of Ukraine LLC (December 11, 2023);
- working consultations with representatives of the Regulator (NEURC) on 04/04/2024 and 04/26/2024 on issues of reforming and developing the electricity and gas markets, the development of renewable energy.

In the course of the approval procedure of the NECP project, more than 170 comments and observations were processed by the interested bodies, most of them were taken into account.

In addition, the following public online consultations were held on the dimensions of the NECP and on individual cross-sectoral issues:

- "Energy efficiency in municipalities" (November 29, 2023, about 150 registered participants):

As part of the consultation, the participants raised the issue of the delay in the development of secondary legislation. In particular, at the time of the consultations, the issue of developing local energy plans had not been settled, the mechanism for local government access to information from suppliers of electricity and natural gas was noted to be ineffective, and secondary legislation for the certification of energy auditors had not been prepared.

- "Energy Security" (November 30, 2023, about 110 registered participants);

In the course of the discussion, the participants expressed proposals for strengthening the stability of the energy system, including the protection of critical infrastructure, in the conditions of attacks by the Russian Federation. The discussion also concerned such issues as the economic rationale for the restoration of oil refining, the realistic terms of the formation of minimum reserves of oil and oil products, ensuring greater flexibility of the energy system.

- "Decarbonization: development of RES" (December 13, 2023, about 100 registered participants):

As part of the online consultation, the basis of RES development goals, as well as existing and planned policies were presented. The participants discussed the problems of RES sector development, the effectiveness of current policies and the need to introduce new ones.

In the context of renewable gasses, issues were raised regarding the negative impact of regulated prices and the ban on gas exports on the development of the industry, the difficulties of interacting with GDSO/OSR during the connection, the non-competitive cost of connection and other problems, which together can make it possible to achieve production of only 50-100 million m³ biomethane by 2030, the need to adapt existing support mechanisms to small producers, as well as integration into the Union Database for Biofuels.

- "Decarbonization: integration of RES into energy systems and markets" (December 14, 2023, about 70 registered participants):

In the context of the development and integration of renewable energy sources into the power system and the electricity market, the issues of integration of markets with EU countries (market coupling),

mechanisms for ensuring the sufficiency of generating capacities, in particular capacities for reserving generating facilities based on renewable energy sources, were discussed. In the context of renewable gasses, the issues were discussed regarding the difficulties of connecting biomethane production facilities to gas and electricity networks, the need to determine the further fate of gas distribution networks, improving their condition, regulating the use of gas for production and technological needs, as well as ensuring the cost-reflectivity in operators' tariffs (in including the GTS operator for the second regulatory period of 2025-2030).

- "Decarbonization: policies and measures to reduce GHG emissions" (December 18, 2023, about 80 registered participants);

The main topics of the discussion concerned the realism of the goals and effectiveness of the main policies and measures to reduce greenhouse gas emissions, including the procedure for deploying the emissions trading system, reforming the environmental tax for carbon dioxide emissions, as well as additional measures for decarbonization in the sectors of agriculture, LULUCF, and waste.

- "Research, innovation and competitiveness" (January 8, 2024, about 100 registered participants);

During the consultations, an active discussion took place regarding the renewal of educational and scientific priorities, targeted investments for the development of production and export of energy and climate technologies, as well as closing the need for specialists in the fields of clean production and carbon-free energy.

- "Development of energy markets for 2025-2030." (January 16, 2024, about 150 registered participants):

In the context of the development of the electricity market, the issues of integration/unification with the markets of EU countries (market coupling) and the choice of the NEMO model were discussed; liberalization of pricing, in particular the gradual elimination of PSO mechanisms, the use of price caps; mechanisms for ensuring the sufficiency of generating capacities; the development of "smart" networks, the stimulating regulation of OSR and target indicators for the reduction of electricity losses in networks; formation of debts in the market. In the context of the gas market, the issues were raised as regards the need to cancel PSO and the moratorium on prices for consumers, the separate development and analysis of the energy market for use in transport, including such fuels as CNG and LNG.

- "Increasing the energy efficiency of enterprises and energy companies" (January 18, 2024, 115 registered participants):

Among the main directions that require additional efforts of the state, the participants noted the creation of financial support tools for enterprises for the implementation of energy-efficient measures.

- "Motor fuel market and its decarbonization (oil refining, import, development of RES in transport)" (January 25, 2024, about 75 registered participants):

During the discussion, it was noted the need for a more systematic state attention to the issue of energy use in transport. The issues of developing alternative types of fuel (CNG, LNG), ensuring the preservation of minimum reserves of oil and oil products, as well as obligations regarding mixing fuels with components of biological origin were raised.

In the course of public consultations after the publication of the draft NECP, more than 550 comments, remarks and suggestions were received and processed from various groups of stakeholders, including business entities and business associations (Naftogaz of Ukraine, LLC "Operator of the Gas Transport System of Ukraine", JSC "Ukrtransgaz", LLC "Ukrainian Energy Exchange", LLC "Orlen Ukraine", European Business Association, Ukrainian Wind Energy Association, Ukrainian Association of Bioethanol Producers), public associations (Association of Coal Communities of Ukraine, World Wide Fund for Nature Ukraine (WWF-Ukraine), Center for Environmental Initiatives "Ekodiya", "Energy Transition" Coalition), analytical centers and advisory bodies (Green Deal Ukraine, Recovery and Reform Support Team under the Ministry of Energy), international financial organizations (European Bank for Reconstruction and Development), international aid projects (USAID energy security project), natural persons.

In compliance with the requirements of the Law of Ukraine "On Strategic Environmental Assessment", a strategic environmental assessment (SEA) was conducted by assessing the likely significant impacts on the environment during the implementation of the NECP project. In the process of SEA, an analysis of the impact of the implementation of the decisions of the NECP project on individual components of the natural environment, as well as the overall impact on natural processes and complexes, was carried out. A significant negative impact on the environment and public health during the planned activity is not expected. The draft NECP duly takes into account the SEA report, the results of public discussion and consultations. For more details, see Unified register of the SEO, case number 26-03-5322-24.

iv. Consultations of other Contracting Parties and Member States of the European Union

As part of the preparation of the NECP, a High Level Advisory Group (HLAG) was established with the participation of representatives of the European Union, the Secretariat of the Energy Community and the governments of the G7 countries. During regular meetings, HLAG participants were presented with key objectives, policies and measures of the NECP, key assumptions and preliminary modeling results, and discussed how to overcome the main challenges for harmonizing energy and climate policies.

Official letters with an invitation to submit comments and proposals to the NECP draft were sent to neighboring EU member states and Contracting Parties of the Energy Community. Comments were received from the Republic of Poland, which were discussed at the HLAG meeting on March 4, 2024. Comments related to the need for consultations at an early stage between operators of electricity transmission systems regarding the development of prospective projects of interstate connections (and, accordingly, the expediency of mentioning individual projects of interconnectors), compliance with technical requirements for the synchronous operation of the energy system of continental Europe. In the gas sector, comments related to technical and economic analysis, in particular demand assessment and business case construction, with the aim of increasing guaranteed capacity on existing interstate connections. The issues of updating the status of the "Brody - Adamova Zastava" project, potential cooperation in the trade of renewable gases (biomethane, hydrogen) and repurposing of the gas infrastructure, policies to reduce emissions in the sector of GHG were also discussed.

On May 3, 2024, bilateral consultations were held with representatives of the Republic of Moldova. The Moldovan side was interested in the issue of taking into account in the NECP draft of the territories where hostilities are (were) being conducted or temporarily occupied by the Russian Federation, plans to launch ETS, prospects for replacing coal-fired power generation with new technologies and the corresponding impact on the possibilities of exporting electricity from Ukraine, coordinated development of infrastructure.

In turn, the representatives of the government of Moldova presented their draft NECP, including key goals and targets, a list of policies and measures, and modeling results. The discussion concerned, among other things, the integration of the electricity markets of Ukraine and Moldova with the EU market, measures to implement Regulation (EU) 2022/869 on guidelines for trans-European energy infrastructure, development of gas transport infrastructure (Trans-Balkan pipeline, "Vertical Corridor" initiative), use Ukrainian gas storage capacities, time frames for the liberalization of energy markets, increasing the share of RES in the transport sector. The Ukrainian side had the opportunity to receive answers to questions regarding decarbonization measures in the field of heat supply, increasing the share of RES in the industrial and building sectors.

v. Iterative process with the Secretariat

The European Commission and the Secretariat of the Energy Community were involved in the High Level Advisory Group (HLAG) meetings. Also, the relevant directorates of the European Commission and the Secretariat of the Energy Community provided comments on the previous draft of the NECP.

On March 22, 2024, a presentation of the NECP project was held in Brussels with the participation of representatives of the Government of Ukraine and representatives of the European Commission, in particular the Directorate General for Energy (DG ENER), the Directorate General for Neighborhood Affairs and Enlargement Negotiations (DG NEAR), the Directorate General for Combating climate change (DG CLIMA), other stakeholders from the European Commission.

In accordance with the requirements of Regulation (EU) 2018/1999, the draft NECP was submitted to the Secretariat of the Energy Community for recommendations and their further processing for the preparation of the final draft of the NECP. The recommendations were duly considered and taken into account. Representatives and structural divisions of the European Commission were involved in the process on an ongoing basis for the purpose of information and discussions.

1.4. Regional cooperation in preparing the plan

i. Elements subject to joint or coordinated planning with other Contracting Parties and Member States of the European Union

By decision 2022/02/MC-EnC ⁸⁸ of December 15, 2022, the Council of Ministers of the Energy Community adopted the common energy and climate goals of the Contracting Parties until 2030. Among other things, the following goals have been set for Ukraine:

- Reduction of greenhouse gas emissions by 65% compared to the level of 1990 to 309 million tons of CO₂-eq.;
- The share of renewable energy sources in the structure of gross final energy consumption is at least 27%;
- Primary energy consumption is no more than 91.47 million tons of energy, final energy consumption is 50.45 million tons of energy.

The Contracting Parties of the Energy Community should take a coordinated approach to the implementation of policies to reduce dependence on fossil fuels in the short term and achieve climate neutrality of their economies by 2050. At the same time, as far as Ukraine is concerned, the goals should be revised at the meeting of the Council of Ministers of the Energy Community, following the termination of martial law in Ukraine.

All issues related to construction, expansion, as well as legal provision of guaranteed access to cross-border infrastructure, in particular in the field of gas-methane, oil, hydrogen and electricity, require a joint and coordinated solution.

ii. Explanation of how regional cooperation is considered in the plan

In appropriate cases, NECP describes measures of regional cooperation. Among other things, this concerns cooperation in terms of the development of the electricity transmission system and GTS, in terms of regional integration of markets and trade development, in terms of risk assessment and planning of response measures to crises in the supply of energy resources, in terms of reducing emissions through the conclusion of agreements on bilateral cooperation in within the framework of Article 6 of the Paris Agreement.

⁸⁸ https://www.energy-community.org/dam/jcr:421f0dca-1b16-4bb5-af86-067bc35fe073/Decision_02-2022-MC_CEP_2030targets_15122022.pdf

2. NATIONAL OBJECTIVES AND TARGETS

2.1. Dimension decarbonisation

2.1.1. GHG emissions and removals

i. The elements set out in point (a)(1) of Article 4

The updated nationally determined contribution of Ukraine to the Paris Agreement, which the Government approved on July 30, 2021⁸⁹, significantly strengthened⁹⁰ Ukraine's contribution to combating global climate change. Thus, the document envisages **a reduction of Ukraine's total GHG emissions by 65% by 2030 compared to the level of emissions in 1990**⁹¹. The same goal is recorded in the decision of the Council of Ministers of the Energy Community 2022/02/MC-EnC⁹².

Ukraine's national target for reducing GHG emissions covers all GHG⁹³ emissions and all sectors (energy, industrial processes and product use, agriculture, GHG, waste). Ukraine's obligation under the updated NDC includes temporarily occupied territories, although there is no information on economic activity and the level of GHG emissions on these territories (expert assessments have been carried out). It is assumed that the NDC will be revised after the restoration of the territorial integrity of Ukraine.

According to the National Inventory of GHG Emissions for 1990-2018, GHG emissions of Ukraine (including LULUCF sector) in 1990 amounted to 882.9 million tons of CO₂-eq.⁹⁴. Accordingly, the goal of reducing GHG emissions by 65% from the 1990 level will mean setting emissions at the level of 309 million tons of CO₂-eq in 2030.

According to the National Inventory of GHG Emissions for 1990-2021⁹⁵, GHG emissions amounted to 341.5 million tons of CO₂-eq. (taking into account the LULUCF sector) in 2021. This is 62.5% less than in 1990, but 7.5% more than in 2020.

The development of the second NDC of Ukraine is planned for 2025.

ii. Where applicable, other national objectives and targets consistent with the Paris Agreement and the existing long-term strategies. Where applicable for the contribution to the overall Contracting Parties' commitment of reducing the GHG emissions, other objectives and targets, including sector targets and adaptation goals, if available

The long-term goals of achieving climate neutrality are recorded in two strategic documents of Ukraine. The Energy Strategy of Ukraine for the period until 2050 envisages **the achievement of climate neutrality of the energy sector of Ukraine by 2050**⁹⁶.

⁸⁹ <https://www.kmu.gov.ua/news/uryad-shvaliv-cili-klimatichnoyi-politiki-ukrayini-do-2030-roku>

⁹⁰ The first NDC actually envisaged a reduction of GHG emissions by 40% by 2030 from the 1990 level. The updated NPP increased the GHG emissions reduction target to 65% of 1990 levels.

⁹¹ https://unfccc.int/sites/default/files/NDC/2022-06/Ukraine%20NDC_July%2031.pdf

⁹² <https://www.energy-community.org/legal/decisions.html>

⁹³ Carbon dioxide - CO₂, methane - CH₄, nitrogen oxide (I) - N₂O, hydrofluorocarbons - HFC, perfluorocarbons - PFC, sulfur hexafluoride - SF₆, nitrogen trifluoride - NF₃.

⁹⁴ This reference value may be revised in case of a revision of the methodology in the Intergovernmental Panel on Climate Change (IPCC) guidance.

⁹⁵ <https://unfccc.int/ghg-inventories-annex-i-parties/2023>

⁹⁶ <https://zakon.rada.gov.ua/laws/show/373-2023-%D1%80#Text>

The National Economic Strategy for the period until 2030⁹⁷ refers **to the need to achieve climate neutrality (for the economy as a whole) by 2060**. In addition, the draft Law of Ukraine "On the Basic Principles of State Climate Policy" (Reg. No. 11310 of May 31, 2024)⁹⁸ states that the long-term goals of state climate policy are:

1) achieving climate neutrality through a socially just and economically efficient transition to help keep the increase in global average temperature below 2°C above pre-industrial levels and making efforts to limit the increase in temperature to 1.5°C above pre-industrial levels by reducing greenhouse gas emissions and increasing absorption by absorbers of greenhouse gasses in accordance with Article 2 of the Paris Agreement;

2) increasing resilience and reducing risks, including for public health, related to climate change, by implementing climate change adaptation measures in accordance with Article 7 of the Paris Agreement.

Ukraine also made additional commitments to reduce methane emissions by joining the Global Methane Pledge initiative, which was announced during the UNFCCC conference of parties in Glasgow in November 2021. To implement Ukraine's climate policy within the framework of participation in the Global Methane Pledge, the Government approved a plan of measures⁹⁹ on July 7, 2023 (see the description of the planned measures in section 3.1).

The goal of reducing methane emissions is formulated as the expected result of fulfilling a number of tasks provided for in the Action Plan - **reducing methane emissions by 30% by 2030 from the level of 2020**, as provided by the "Global Methane Pledge" initiative.

According to the National Inventory of GHG Emissions for 1990-2021¹⁰⁰, in 2020 methane emissions amounted to 72 million tons of CO₂-eq., in 2021 - 71.5 million tons of CO₂-eq., which is about 21% of the total GHG emissions of Ukraine. Accordingly, reducing emissions in this sector by 30% (21.6 million tons of CO₂-eq.) from the level of 2020 ensures a reduction of total GHG emissions by 2.4% by 2030 from the base year of 1990.

Ukraine also has an important sectoral goal that will contribute to the reduction of GHG emissions. In 2021, Ukraine joined the Powering Past Coal Alliance¹⁰¹ coalition during the international conference in Glasgow and announced the goal of phasing out coal in the electricity generation by 2035. The ESU confirmed the previously announced plans, in particular, it stated that **the use of coal-fired generation will be reduced until it is completely decommissioned in 2035**. However, the feasibility of achieving this goal by 2035 will be assessed after the end of a full-scale invasion of the Russian Federation into Ukraine, taking into account the state and available capacities that will remain operational after the end of hostilities.

In the transport sector, strategic documents also set several important goals. Thus, the National Transport Strategy of Ukraine for the period until 2030¹⁰² envisages **a reduction of specific fuel consumption by 10 ton-kilometers by 30% by 2030**. According to the ESU, electricity consumption in the sector is expected to grow by up to 11% in 2032 due to the electrification of transport. In particular, it is assumed that the share of electric transport will be 15% in 2032. At the same time, a new transport strategy is currently being developed, which may set new goals.

⁹⁷ <https://www.kmu.gov.ua/npas/pro-zatverdzhennya-nacionalnoyi-eko-a179>

⁹⁸ <https://itd.rada.gov.ua/billInfo/Bills/Card/44348>

⁹⁹ Decree of the Cabinet of Ministers of Ukraine of July 7, 2023 No. 607 "On approval of the plan of measures for the implementation of Ukraine's climate policy within the framework of participation in the global initiative to reduce methane emissions "Global Methane Pledge" (Official Gazette of Ukraine, 2023 p., No. 67, Article 3842). <https://zakon.rada.gov.ua/laws/show/607-2023-%D1%80#Text>

¹⁰⁰ https://unfccc.int/sites/default/files/NDC/2022-06/Ukraine%20NDC_July%2031.pdf

¹⁰¹ A coalition of national and subnational governments, businesses and organizations working to promote the transition from coal-fired power generation to renewable energy sources.

¹⁰² <https://zakon.rada.gov.ua/laws/show/430-2018-%D1%80#Text>

In recent years, Ukraine has also begun to develop a national policy in the field of adaptation to climate change. Thus, by order of the Cabinet of Ministers of Ukraine No. 1363 of October 20, 2021, the Strategy for Environmental Security and Adaptation to Climate Change for the Period Until 2030 was approved (Official Gazette of Ukraine, 2021 p., No. 87, Article 5584)¹⁰³ with the aim of increasing the level of environmental safety, reducing the effects and consequences of climate change in Ukraine.

Energy is identified as one of the socio-economic sectors that are vulnerable to climate change, as the expected consequences pose threats to the reliable energy supply of all types of consumers. In particular, the deepening of seasonal and daily changes in energy demand as a result of climate change will complicate the balancing of the United Energy System of Ukraine. In addition, extreme weather events can increase the emergencies in power grids.

One of the goals of the Strategy is **to strengthen the adaptive capacity and resilience of social, economic and ecological systems to climate change**, to achieve which a number of tasks and measures have been formulated.

2.1.2. Renewable energy

i. The elements set out in point (a)(2) of Article 4

National indicative targets in the field of renewable energy (RES) were developed for the draft NREAP¹⁰⁴, which was prepared before a full-scale invasion of the Russian Federation into Ukraine. The draft NREAP determines that **the share of energy carriers produced from renewable energy sources in the structure of total final energy consumption should be at least 27% in 2030**. The same target indicator is recorded in the Decision of the Council of Ministers of the Energy Community 2022/02/MC-EnC¹⁰⁵.

During 2022, the draft NREAP underwent alignment of proposals with ministries and central executive bodies and a strategic environmental assessment. However, on April 21, 2023, the Government approved a new Energy Strategy of Ukraine for the period up to 2050, in particular to take into account the devastating impact of a full-scale invasion of the Russian Federation into Ukraine on Ukraine's energy sector. Accordingly, the draft NREAP is currently being revised to align with the EU goals and provisions, as well as take into account the consequences of a full-scale invasion by the Russian Federation.

According to the results of the modeling carried out as part of the development of the NECP, the achievement of the target indicator for the development of RES - 27% in the total final consumption occurs under the condition of the implementation of the scenario with planned policies and measures (WAM).

ii. Estimated trajectories for the sectoral share of renewable energy in final energy consumption from 2025 to 2030 in the electricity, heating and cooling, and transport sector

The national indicative targets for RES in total final energy consumption until 2030 in heating and cooling systems, in electricity production and in the transport sector, estimated for the WAM scenario, are presented in table 2.1 of this Plan, in particular, in the sectors:

¹⁰³ <https://zakon.rada.gov.ua/laws/show/1363-2021-%D1%80#Text>

¹⁰⁴ https://sae.gov.ua/sites/default/files/DraftNPDVE_2030_SAE_21_09_2022.pdf

¹⁰⁵ <https://www.energy-community.org/legal/decisio>

- power generation — an increase in the share of energy from RES by almost 3 times from 2020 to 2030 — from 10.7% to 29.4%;
- heating and cooling — a 3.5-fold increase in the share of renewable energy from 2020 to 2030 — from 9.3% to 32.5%;
- increasing the share of energy from renewable sources in consumption by the transport sector by 7 times from 2020 to 2030 — from 2.5% to the level of 17.2%.

Table 2.1. National indicative target for renewable energy sources in total final energy consumption by 2030 in heating and cooling, power generation and transport (percentage)

The sector of RES energy use	2020 year	2025 year	2026 year	2027 year	2028 year	2029 year	2030 year
Heating and cooling ⁽¹⁾	9.3	20.8	23.2	24.6	26.7	28.6	32.5
Electricity ⁽²⁾	10.7	20.9	23.9	27.8	30.5	31.1	29.4
Transport ⁽³⁾	2.5	4.9	7.3	10.1	12.7	15.9	17.2
Total final energy consumption ⁽⁴⁾	8.4	17.3	19.5	21.6	23.7	25.3	27.1

1 Share of renewable energy in heating and cooling systems: total final consumption of energy from renewable sources for heating and cooling (as defined in [Articles 7\(1b\)](#) and [7\(3\) of Directive 2018/2001/EC](#)), divided by the total final amount of energy consumption for heating and cooling. 2 Share of renewable energy in electricity: total final volume of electricity consumption from renewable sources for electricity (as defined in [Articles 7\(1\)\(a\)](#) and [7\(2\) of Directive 2018/2001/EC](#), without taking into account the normalization of electricity produced by wind and hydropower plants (with normalization, the share of energy from renewable sources in electricity consumption is - 13.9%), divided by the total final volume of electricity consumption.

3 Share of renewable energy in the transport sector: the final volume of energy from renewable sources consumed in the transport sector (as defined in [Articles 7\(1\)\(c\)](#) and [7\(4\) of Directive 2018/2001/EC](#)), divided into the amount of consumption of gasoline, diesel fuel, biofuel used by road and rail transport, and electricity consumed by land transport.

4 Share of renewable of energy in the gross final energy consumption (determined without taking into account the normalization of electricity produced by wind and hydropower plants (taking into account the normalization, the share of energy from renewable sources in the gross final energy consumption is 9.2%).

iii. Estimated trajectories by renewable energy technology that the Contracting Party projects to use to achieve the overall and sectoral trajectories for renewable energy from 2025 to 2030, including expected total gross final energy consumption per technology and sector in Mtoe and total planned installed capacity (divided by new capacity and repowering) per technology and sector in MW

Detailed evaluation trajectories for renewable energy technology will be developed during the revision of the draft NREAP.

iv. Estimated trajectories on bioenergy demand, disaggregated between heat, electricity and transport, and on biomass supply by feedstocks and origin (distinguishing between domestic production and imports). For forest biomass, an assessment of its source and impact on the LULUCF sink

Detailed evaluation trajectories for renewable energy technology will be developed during the revision of the draft NREAP.

v. *Where applicable, other national trajectories and objectives, including those that are long term or sectoral (e.g. share of renewable energy in district heating, renewable energy use in buildings, renewable energy produced by cities, renewable energy communities and renewables self-consumers, energy recovered from the sludge acquired through the treatment of wastewater)*

In addition to the indicative goals for the development of the RES sector presented above, several other strategic documents of Ukraine also include goals for RES, which were taken into account for the development of the NECP.

Thus, the NES has set the goal **for reaching the share of generation from renewable energy sources in the total production of electricity at the level of 25% in 2030.**

In the Concept of implementation of state policy in the field of heat supply ¹⁰⁶, approved by the Decree of the Cabinet of Ministers of Ukraine of August 18, 2017 No. 569 (Official Gazette of Ukraine, 2017 p., No. 70, Article 2127) (hereinafter - Concept of implementation of state policy in the field of heat supply), set goals for **achieving the share of alternative energy sources (renewable energy sources and secondary energy resources) in the production of thermal energy by objects in the field of heat supply in 2025 – 30%, in 2035 – 40%.**

The National Transport Strategy of Ukraine for the period until 2030¹⁰⁷, which was approved by the Order of the Cabinet of Ministers of Ukraine of May 30, 2018 No. 430 (Official Gazette of Ukraine, 2018 p., No. 52, Article 1848), provides for **an increase in the use of alternative types of fuel (biofuel or its mixture with traditional fuel) and electricity (produced from both traditional and renewable sources) in the transport sector up to 50% by 2030.**

2.2. Dimension energy efficiency

i. The elements set out in point (b) of Article 4

1) Indicative national contribution in the field of energy efficiency to the achievement of energy efficiency improvement targets, as specified in Article 1(1) and Article 3(5) of Directive 2012/27/EU, based on primary or final energy consumption, saved primary or final energy or energy intensity .

The current national indicative goals for energy efficiency are determined by the Decision of the Council of Ministers of the Energy Community 2022/02/MC-EnC and the National Action Plan for Energy Efficiency for the period until 2030, approved by the Decree of the Cabinet of Ministers of Ukraine of December 29, 2021 No. 1803 (Official Gazette of Ukraine, 2022 r., No. 8, Article 439). According to these documents, primary energy consumption in Ukraine in 2030 should not exceed 91,468,000 tons of energy, and final energy consumption should not exceed 50,446,000 tons of energy.

¹⁰⁶ <https://zakon.rada.gov.ua/laws/show/569-2017-%D1%80#Text>

¹⁰⁷ <https://zakon.rada.gov.ua/laws/show/430-2018-%D1%80#Text>

Taking into account the consequences of the full-scale invasion of the Russian Federation into Ukraine and its impact on the economy in general and the energy sector in particular, as well as changes in the demographic situation, the indicative values of primary and final energy consumption were revised as part of the preparation of the NECP. The targets of primary and final energy consumption were determined based on the results of modeling using TIMES modeling, which allows taking into account both technical and economic aspects of energy systems.

Table 2.6. Indicative primary energy consumption and final energy consumption targets, thousand t.e.

The ESU also envisages a decrease in the overall energy intensity of the economy from approximately 89 toe/mln USD (in 2020 prices) in 2023 up to 76 toe/mln USD in 2032. It is assumed that the target will be achieved as a result of implementation of measures aimed at improving the efficiency of energy use in all sectors of the economy. The National Economic Strategy until 2030 also sets a sectoral target of 30% decrease of energy intensity of the extractive industry by 2030.**to be achieved between 2021 and 2030 in accordance with point (b) of Article 7(1) of Regulation (EC) 2018/1999 on energy saving obligations under the 2012 Directive /27/EU**

Table 2.7. Calculation of the cumulative end-use energy savings for the years 2021-2030, thousands of tons.

2030	314.55	314.55	314.55	314.55	314.55	314.55	314.55	314.55	314.55	314.55	314.55	3145.52
Cumulative volume of saved energy during final use												17300.36

Source: calculation in accordance with the Methodology for determining the target indicator of the annual reduction of energy consumption, approved by the order of the Ministry of Infrastructure of November 2, 2023. No. 1006

3) Indicative intermediate indicators of the Long-term strategy for the thermal modernisation of buildings under state, communal and private ownership, a road map with internally defined measurable indicators of progress, an empirically based assessment of the expected amount of energy savings and other benefits, as well as contributions to the achievement of the Union's energy efficiency improvement targets, respectively to Directive 2012/27/EU and Article 2(a) of Directive 2010/31/EU.

The Ministry of Infrastructure has been developed, and the Decree of the Cabinet of Ministers of Ukraine of December 29, 2023 No. 1228 (Official Gazette of Ukraine, 2024 p., No. 13, Article 843) ¹⁰⁸ approved the Long-Term Strategy for Thermal Modernisation of Buildings for the Period Until 2050. The main goal of the Strategy is decarbonisation of national building stock by 2050. The Strategy sets interim targets for 2030, which include:

- achieving the target energy savings in the government buildings, with an annual decrease of energy consumption of 1% of the area of respective buildings;
- implementation and operation of energy management systems in at least 90% of communities;
- decrease of final energy consumption in the building sector by 15%;
- at least 36% share of residential and public buildings that meet the minimum energy efficiency requirements of the buildings;
- at least 10% share of public near-zero energy buildings;
- the amount of investments attracted to improve energy efficiency of buildings at the level of at least 87 mln euros;
- the amount of qualified personnel in the field of energy efficiency at the level of at least 100,000 people/year.

Target indicators of the share of residential and public buildings that meet the minimum requirements for the energy efficiency of buildings, as well as the share of public buildings meeting nearly-zero energy buildings requirements, inter alia, rehabilitation and new construction of buildings to replace damaged or destroyed buildings, in compliance with the principle "Build Back Better".

¹⁰⁸ <https://zakon.rada.gov.ua/laws/show/1228-2023-%D1%80#Text>

The collection, accumulation, accounting, processing, storage and protection of information on real property damaged and destroyed as a result of hostilities, acts of terrorism, sabotage caused by the armed aggression of the Russian Federation against Ukraine is carried out with the help of the State Register of Property Damaged and Destroyed as a result of hostilities, terrorist acts acts of sabotage caused by the armed aggression of the Russian Federation against Ukraine (hereinafter - the Register of Damaged and Destroyed Property). The Ministry of Infrastructure is the holder of the Register of Damaged and Destroyed Property. Analytical and statistical information (documentation) can be generated based on the data of the Register of Damaged and Destroyed Property, as well as the information can be used by the Ministry of Infrastructure to formulate plans for the restoration of buildings.

Table 2.8. Some expected results of the first stage of the Building Thermal Modernisation Strategy for the period until 2050

Name	Unit of measurement	Residential buildings		Non-residential buildings	
		individual	BKB	public	other non-residential
Thermomodernized buildings (completely or partially)	unit	3,088,352	97,916	15,784	74 192
Areas of buildings have been updated	million m ²	220.6	260.0	59.4	66.8
Annual savings of natural gas (natural gas equivalent)*	billion m ³	2.5 (8.37)	0.71 (2.36)	0.17 (0.58)	0.12 (0.40)
Annual savings of thermal energy	GWh	31,606	22,595	7,389	5 136
Annual saving of electrical energy	GWh	247	453	1,062	1 105
Annual savings	million euros	1,022.2	939.2	580.3	397.9
* Annual savings of natural gas in accordance with its share in the generation (30%) of thermal energy (and the estimated volume of energy savings in the equivalent of natural gas)					

The expected level of thermal modernisation of buildings in LTRS is determined on the basis of an ambitious scenario. In view of the negative consequences of a full-scale invasion of the Russian Federation into Ukraine, including the difficulty of attracting private investment and debt capital, for the purposes of NECP, the basic scenario of thermal modernisation, described in the Strategy for consideration in the construction of the WAM scenario, was taken into account. According to the base scenario, thermal modernisation of 10% of buildings is assumed.

At the same time, it should be noted that after the introduction and filling of the National Database of Operational and Energy Characteristics of Buildings (PM_EE_WEM_08 National Database of Energy and Operational Characteristics of Buildings), taking into account the accumulation of current information on the volumes, condition and needs of the building stock of Ukraine, and taking into account the consequences of full-scale invasion of the Russian Federation into Ukraine, it will be necessary to revise the Strategy for Thermal Modernisation of Buildings for the period until 2050, in particular, with the aim of updating the pace of thermal modernisation of buildings and the values of the expected target indicators.

The concept of implementation of the state policy in the field of ensuring the energy efficiency of buildings in terms of increasing the number of nearly-zero energy buildings (hereinafter - the NZEB Concept) also defines target indicators for improving energy efficiency in the building sector. Thus, the NZEB Concept envisages achieving a reduction of final energy consumption in the residential sector by 24% and a reduction of final energy consumption in public buildings by 16% in 2025.

4) The total useful area to be renovated or equivalent annual amounts of energy savings to be achieved from 2021 to 2030 in accordance with Article 5 of Directive 2012/27/EU on the exemplary role of public authority buildings.

Ukraine has chosen an alternative approach to the implementation of Article 5 of Directive 2012/27/EU. The target energy saving in government buildings is expressed as a numerical value of annual decrease of energy consumption, which is achieved as a result of bringing to minimum energy efficiency requirements the buildings, which area is at least 1% of the area of buildings that meet all the following characteristics:

- 1) which are in state or communal ownership;
- 2) which are occupied by central executive body;
- 3) which heated area exceeds 250 square meters.

According to preliminary estimates of the Ministry of Infrastructure, there are approximately 100 buildings that meet the above-mentioned characteristics. The average heated area of a public building in Ukraine is 9,447.5 cubic meters, the average specific energy consumption for public buildings is 51.69 kWh/cubic meter. The average value of minimum requirements for public buildings is 25 kWh/m³. Therefore, bringing such buildings in compliance with minimum requirements can decrease energy consumption by 51%. The expected energy savings in buildings that meet the above-mentioned characteristics is 21.4 toe/year and 192.4 toe by 2029.

At the same time, it should be noted that in order to determine and monitor the achievement of the target indicator of energy saving in the buildings of state authorities in accordance with the Law of Ukraine "On the Energy Efficiency of Buildings", it is necessary to form a database of buildings of state authorities, which is a general component of the National Database of Buildings (PM_EE_WEM_08 National database of energy and operational characteristics of buildings).

ii. The indicative milestones for 2030, 2040 and 2050, the domestically established measurable progress indicators, an evidence-based estimate of expected energy savings and wider benefits, and their contributions as included in the roadmaps set out in the long-term renovation strategies for the national stock of residential and non-residential buildings, both public and private, in accordance with Article 2a of Directive 2010/31/EU as adapted and adopted by Ministerial Council Decisions 2010/02/MC-EnC and 2021/14/MC-EnC

See above, in section 2.2.i. of this Plan (indicators of the Long-term strategy of thermal modernization of buildings for the period until 2050).

iii. Where applicable, other national objectives, including long-term targets or strategies and sectoral targets, and national objectives in areas such as energy efficiency in the transport sector and with regard to heating and cooling

Heat supply

The current targets for the field of heat supply are determined by the Concept of the implementation of the state policy in the field of heat supply, as approved by the Order of the Cabinet of Ministers of Ukraine No. 569 of 18.08.2017, the period of implementation of the Concept is 2017-2035. According to the Concept, the following targets were expected to be achieved by 2025:

- ensuring 100% commercial metering of consumed thermal energy;
- specific consumption of conventional fuel during the production of thermal energy by boiler houses – 155 kg/Gcal at the first stage of the implementation;
- share of losses in heating systems – 12% in the first and 10% in the third stage of the implementation.

As of 2024, it can be stated that only a part of the measures envisaged by the Concept have been implemented and key target indicators have not been achieved. It is necessary to monitor the current state of development in the field of heat supply, determine the directions of development of the field and update target indicators, and adopt, based on such analytical work, an updated program document to replace the current Concept (PM_EE_WAM_08 Update of the Concept of State Policy Implementation in the Field of Heat Supply).

2.3. Dimension energy security

i. The elements set out in point (c) of Article 4

The key documents defining the goals in terms of **deepening the diversification of sources and ways of supplying energy resources** from third countries with the potential goal of reducing dependence on the import of energy resources are NES, ESU, as well as the Energy Security Strategy¹⁰⁹.

Increasing the flexibility of the national energy system is not directly declared as a clear goal in policy documents.

Among its goals, the NES includes ensuring the formation of the volume of flexible capacities sufficient to ensure the economically feasible operation of all types of power generation.

The Energy Security Strategy includes two relevant strategic goals:

- Goal 2. Resilience of the functioning of the energy sector;
- Goal 4. Efficiency of the use of energy resources and energy efficiency of the national economy.

One of the tasks of the ESU includes, in order to ensure the balance reliability of the UES of Ukraine and support the further integration of RES, the introduction of highly maneuverable capacities:

- flexible capacities of hydroelectric and pumped hydropower stations;
- balancing and reserve capacities of TPPs on combined fuel (natural gas and/or biomethane), other technologies; gas turbine and gas piston installations are also mentioned;
- capacities of energy storage facilities, including Power-to-X long-term (seasonal) storages.

The target indicators for 2032 in terms of total available capacity is 9.4 GW of semi-peak and peak generation (without detailing technologies), as well as 4.9 GW of hydroelectric power plants and 4.1 GW of pumped hydropower plants. The increase in available HPP capacity will be 30%, the PHPP capacity will be approximately 2.4 times. At the same time, the ESU contains a reference to the Hydropower Development Program of Ukraine for the period until 2026¹¹⁰, which includes the goal of increasing the share of flexible capacities of HPPs and PHPPs in the total balance by 2026 with an indicator of 15.5%.

As for ESS, their active use is predicted after 2032. By 2050, compared to the forecast year of 2024, the ESS capacity will triple to 1.56 GW. As part of the demand management program, which should become a separate area of energy efficiency, the ESU envisages only the implementation of pilot projects until 2032.

Detailed target indicators are presented by the TSO in the 2023 adequacy assessment report (see also section 2.4.3. Market integration, Dimension "Internal Energy Market").

The issue **of eliminating restrictions or interruptions in the supply of energy resources** in order to increase the stability of regional and national energy systems is indicated in the provisions of the ESU, the Cybersecurity Strategy of Ukraine¹¹¹, approved by the Decree of the President of Ukraine No. 447 of August 26, 2021, the Laws of Ukraine "On Critical Infrastructure"¹¹², "On Basic Principles of Cyber Security

¹⁰⁹ <https://zakon.rada.gov.ua/laws/show/907-2021-%D1%80#Text>

¹¹⁰ https://ips.ligazakon.net/document/view/kr160552?an=1&ed=2016_07_13

¹¹¹ <https://zakon.rada.gov.ua/laws/show/447/2021#Text>

¹¹² <https://zakon.rada.gov.ua/laws/show/1882-20>

of Ukraine"¹¹³, "On Electricity Market"¹¹⁴, "On Natural Gas Market"¹¹⁵, and regulatory and legal acts on their implementation.

For Ukraine, it is especially important to ensure a constant supply of energy without restrictions or interruptions. That is why much attention is paid to the protection of energy facilities.

Among the goals, the ESU singles out the provision of complex security of infrastructure facilities of the energy sector. The target indicator is the provision of physical, engineering and cyber protection of 100% of facilities. It is stipulated separately that, in the conditions of a full-scale invasion of the Russian Federation into Ukraine, the priority is the protection of critical infrastructure facilities (CIF), the management system of such protection is defined at the level of the Law of Ukraine "On Critical Infrastructure". The Concept of Ensuring the National Resilience System, approved by the Decree of the President of Ukraine of September 27, 2021, No. 479¹¹⁶, also indicates that such a system should provide as a basic element the safety and security of critical infrastructure facilities, in particular, sustainable energy and heat supply.

Another group of policies is the formation and maintenance of reserves of the main fuel and energy resources: natural gas, coal, crude oil and petroleum products. As a rule, target indicators are determined at the government level in the form of orders¹¹⁷ or departmental decisions (plans-schedules) based on the results of the agreement of specific indicators with market players. Some of the goals are regulated at the level of legislation. At the end of 2022, amendments to the Law of Ukraine "On the Natural Gas Market" defined the obligation of the Ministry of Energy to calculate the target level of gas storage filling and to form a filling schedule. In 2023, the Law of Ukraine "On Minimum Reserves of Crude Oil and Petroleum Products"¹¹⁸ was adopted, which provides for the creation of reserves for equivalent of 90 days of net imports or 61 days of domestic consumption.

After all, the framework laws of Ukraine on the gas and electricity markets determine the government's responsibility for the minimum standards of security of supply and their monitoring. The Ministry of Energy is tasked with approving the rules on the security of natural gas and electricity supply, as well as the National Action Plan (regulates preparation and response to a crisis situation regarding the supply of natural gas), which are mandatory for all players of the relevant markets, as well as to monitor security of supply (for electricity – jointly with the Regulator, TSO and other relevant institutions).

All the specified elements found their place in the comprehensive Energy Security Strategy,¹¹⁹ approved by the Cabinet of Ministers of Ukraine Order of August 4, 2021, No. 907 (Official Gazette of Ukraine, 2021, No. 64, Article 4071), which is a strategic planning document, contains analysis of threats, identifies priorities, describes strategic choices, goals and objectives aimed at preventing threats to Ukraine's energy security. Tasks of the Strategy are built around eight strategic goals:

1. Availability of energy sources and energy carriers of all types for consumers;
2. Resilience of the functioning of the energy sector;

¹¹³ <https://zakon.rada.gov.ua/laws/show/2163-19>

¹¹⁴ <https://zakon.rada.gov.ua/laws/show/2019-19#Text>

¹¹⁵ <https://zakon.rada.gov.ua/laws/show/329-19#Text>

¹¹⁶ <https://www.president.gov.ua/documents/4792021-40181>

¹¹⁷ For example <https://zakon.rada.gov.ua/laws/show/586-2021-%D1%80#Text>

¹¹⁸ <https://zakon.rada.gov.ua/laws/show/3484-IX#Text>

¹¹⁹ <https://zakon.rada.gov.ua/laws/show/907-2021-%D1%80#Text>

3. Economic efficiency of the functioning of the energy sector, energy supply systems and import substitution of mineral raw materials;
4. Efficiency of the use of energy resources and energy efficiency of the national economy;
5. Environmentally acceptable impact of energy;
6. Integration of the energy sector into the political, technological, technical, economic and legal space of the EU;
7. Independence of the state in the formation and implementation of domestic and foreign policy in the field of energy, ensuring the realization of national interests;
8. Development of scientific and technical, innovative and educational potential of Ukraine for the needs of the energy sector.

In the context of the EU accession, it is important for Ukraine to integrate into the processes of ensuring security of supply, which is manifested in participation in regional and pan-European risk assessment measures, planning of preventive steps and proper response to crisis situations in the supply of natural gas (according to Regulation (EU) 2017/1938) and electricity (according to Regulation (EU) 2019/941).

ii. National objectives with regard to increasing: the diversification of energy sources and supply from third countries for the purpose of increasing the resilience of regional and national energy systems

The National Security Strategy¹²⁰, approved by the Decree of the President of Ukraine of September 14, 2020, No. 392, among the goals declares the need to diversify the sources and routes of the supply of energy resources. NES defines a general goal in the form of ensuring the diversification of energy supplies at the level of no more than 30% from a single supplier. However, the target is formally set for nuclear fuel (see below), as imports of gas, petroleum products and coal, like electricity, are sufficiently diversified in terms of suppliers' structure and countries of origin – and this trend has intensified since the ban on imports of any goods from the Russian Federation¹²¹ and the actual suspension of trade with the Republic of Belarus.

iii. Where applicable, national objectives with regard to reducing energy import dependency from third countries, for the purpose of increasing the resilience of regional and national energy systems

The Energy Security Strategy includes among the priority tasks:

- on the achievement of Strategic Goal 3 "Economic efficiency of the functioning of the energy sector, energy supply systems and import substitution of mineral raw materials"
 - incentivizing import substitution, in particular through the development of bioenergy, wind energy, justified increase in the extraction of energy resources;
- on the achievement of Strategic Goal 7 "Independence of the state in the formation and implementation of domestic and foreign policy in the field of energy, ensuring the realization of national interests":
 - prevention of increasing Ukraine's dependence on external suppliers, ensuring the appropriate level of diversification of energy resources and technologies, in particular due to an economically justified increase in the share of renewable energy sources

¹²⁰ <https://zakon.rada.gov.ua/laws/show/392/2020#Text>

¹²¹ <https://zakon.rada.gov.ua/laws/show/426-2022-%D0%BF#Text>

and local energy sources in the energy balance of Ukraine; economically justified growth in the production of natural gas and oil, other types of energy resources;

- bringing the volume of coal production in line with the energy needs of Ukraine on the basis of market principles of management and competition with determination of the period of use of coal for energy needs.

Under the strategic goal "Ensuring a high level of energy security and integration of Ukraine into the European energy market", the NES envisages the following indicators:

- formation and maintenance of reserves of crude oil and petroleum products in the amount of at least 90 days of average daily consumption in Ukraine;
- decrease in the level of import dependence (gross import of energy resources in the total primary energy supply) to 33%;
- reduction of the share of a single supplier in the nuclear fuel market to 60%.

In particular, the document notes high import dependence on nuclear fuel (due to the depletion of existing uranium deposits and the high cost of production, own production provides only a third of needs) and gas, a high level of depletion of wells from hydrocarbons production, more than 70% import dependency on petroleum products and a low level of diversification, which collectively form a high risk of potential interruptions in the supply of energy resources for the needs of the economy.

Separately, in the part regarding the development of the extractive industry, NES provides for the strategic goal 3 "Ensuring the satisfaction of the needs of the national economy, creating a reliable basis for the production with high added value" an indicator in the form of providing 100% of the households' needs for natural gas at the expense of own production. At the same time, the prospect of gradual deregulation of the gas market after the end of the martial law regime does not allow to allocate the resource of Ukrainian production for the needs of a specific category of consumers, e.g. population (households). Setting goals for reducing import dependence requires taking into account the complete demand in the economy (that is, all categories of consumers).

Among the goals of the ESU, there is comprehensive integration with the EU energy markets and ensuring the efficient functioning of internal energy markets. One of the indicators of its achievement is the construction of an export-oriented energy industry, which includes, inter alia, the production and exports of hydrogen and alternative gases, equipment and components for the energy sector, various components for nuclear generation, and the implementation of the nuclear cycle from the production of nuclear fuel to the management of radioactive waste.

iv. National objectives with regard to increasing the flexibility of the national energy system, in particular by means of deploying domestic energy sources, demand response and energy storage

See above and section 2.4.3. Market integration (Dimension Internal energy market)

2.4. Dimension internal energy market

2.4.1. Electricity interconnectivity

i. The level of electricity interconnectivity that the Contracting Party aims for in 2030 <...> in accordance with Article 4(d)(1) with a strategy with the level from 2025 onwards defined in close cooperation with affected Contracting Parties and/or Member States of the European Union, taking into account the 2020 interconnection target and the following indicators of the urgency of action:

(1) Price differential in the wholesale market exceeding an indicative threshold of EUR 2/MWh between Contracting Parties and/or Member States of the European Union, regions or bidding zones;

(2) Nominal transmission capacity of interconnectors below 30 % of peak load;

(3) Nominal transmission capacity of interconnectors below 30 % of installed renewable generation.

Each new interconnector shall be subject to a socioeconomic and environmental cost-benefit analysis and implemented only if the potential benefits outweigh the costs

The ESU defines the goal of expanding the total capacity of interconnectors of the UES of Ukraine with the power systems of the ENTSO-E countries to 6 GW by 2032. At the same time, the potential total installed generating capacity in 2032 is estimated at 62.9 GW. Accordingly, the target level of integration (interconnectivity) of the UES of Ukraine is about 10%.

The analysis of price dynamics on the day-ahead markets of Ukraine and EU countries (Poland, Romania, Slovakia, and Hungary) shows that during 2020-2024, the difference between the Base DAM price indices in the vast majority of periods (days) is higher than 2 euros/MWh (relative to Poland - in 97.0% of periods, Romania - 94.1%, Slovakia - 93.9%, Hungary - 94.9%). The average daily difference of Base DAM indices of Ukraine relative to the markets of Poland was 39.6 euros/MWh, Romania – 66.2 euros/MWh, Slovakia – 65.6 euros/MWh, Hungary – 68.9 euros/MW hours.¹²³

The relatively low level of price convergence between the electricity markets of Ukraine and EU countries is not only related to the insufficient capacity of interconnectors. To a large extent, it is also caused by the lack of integration of the spot electricity markets and the regulation of DAM prices by the Regulator (application of upper and lower price caps).¹²⁴

After the start of the full-scale invasion of the Russian Federation into Ukraine on February 24, 2022, electricity consumption in the UES of Ukraine significantly decreased – by approximately 30-35%. Accordingly, the values of peak loads in the power system have also changed. By estimations, in 2024 the ratio of the net transfer capacity (NTC) of interconnectors to the peak load in the UES of Ukraine (17445 MW)¹²⁵ was about 10% for the electricity imports of and 3% for the exports to the EU countries (taking into account the NTC restrictions set by ENTSO-E).¹²⁶

As a result of the full-scale invasion of Ukraine, intense hostilities, especially in the areas with the highest concentration of RES generation facilities in the southern and eastern regions, and systematic shelling of the energy infrastructure of Ukraine, the installed generating capacity of RES facilities operating has changed in the UES of Ukraine, due to their damage, destruction and/or occupation. It is estimated that in 2024 the ratio of interconnectors' NTC to the installed capacity of electricity generation

¹²² The period during 2024, which was considered in the analysis of electricity prices for the Russian Federation, includes January-April 2024.

¹²³ <https://map.ua-energy.org/uk/resources/5bee4464-ba9f-4117-a4ca-f71584bd5f54/>

¹²⁴ <https://map.ua-energy.org/uk/resources/cc738a86-c28e-4a3a-86b6-bd965fd27663/>

¹²⁵ According to the Report on the Assessment of Compliance (Sufficiency) of Generating Capacities to Cover the Forecast Demand for electricity and Ensure the Necessary Reserve in 2023.

¹²⁶

<https://www.entsoe.eu/news/2023/11/28/continental-european-tsos-announce-completion-of-synchronisation-project-with-ukrenergo-and-significant-increase-in-export-capacity-from-continental-europe-to-ukraine/>

from renewables (including large-scale hydro generation) accounted for about 13% (for electricity imports) and 4% (for electricity exports towards EU countries).

All of the above indicators indicate the need to increase the Ukrainian interconnectors' capacity to ensure better integration of electricity markets.

2.4.2. Energy transmission infrastructure

i. Key electricity and gas transmission infrastructure projects, and, where relevant, modernisation projects, that are necessary for the achievement of objectives and targets under the five dimensions of the Energy Union Strategy

Electricity infrastructure

Ukraine does not yet participate in EU projects of common interest (PCI) related to the development of electricity transmission infrastructure. The list and description of the key projects of Ukraine for the development of the transmission system and cross-border lines is included in the 2023-2032 Transmission System Development Plan, developed by the TSO and approved by the Regulator (NEURC).¹²⁷

In order to strengthen cross-border connections, Ukraine implements the following key projects of mutual interest (PMI):

- restoration of the 400 kV overhead transmission line Mukachevo (Ukraine) - Velké Kapusany (Slovakia), aimed at increasing the cross-border capacity to 1,000 MW. The expected capital investment is EUR 10.5 million.¹²⁸ The planned project completion time is 2028;
- restoration and modernization of the 750 kV overhead transmission line Pivdennoukrainska NPP (Ukraine) - Issaccia (Romania), aimed at increasing the cross-border capacity to 1,000 - 1,200 MW. The expected capital investment is EUR 383.3 million.¹²⁹ The planned project completion time is 2028;
- construction of 750/400/330 kV Lvivska substation, which is expected to strengthen connections with ENTSO-E. This project plans to build the 400 kV overhead line Lvivska – Rzeszów 2 in 2027 and the 400 kV Lvivska – Chelm overhead line in 2029. Also, after 2025, the possibility of construction of the 400 kV Lvivska-Krosno substation will be considered.¹³⁰ All of the mentioned new lines are at the pre-design stages, therefore, based on data on the capacity of transmission lines of similar voltages, it is assumed that their capacity will be about 250 MW.

The implementation of all the above-mentioned measures, along with the construction of static reactive power generators (STATCOM) for the purpose of damping low-frequency voltage fluctuations, may, in advance, allow to ensure the level of exports/imports of electricity from/to the UES of Ukraine, which is determined by the UES.

¹²⁷ <https://zakon.rada.gov.ua/rada/show/v0266874-23#Text>

¹²⁸ <https://www.energy-community.org/regionalinitiatives/infrastructure/PLIMA/EL07.html>

¹²⁹ <https://www.energy-community.org/regionalinitiatives/infrastructure/PLIMA/EL09.html>

¹³⁰ According to the Report on the Assessment of Compliance (Sufficiency) of Generating Capacities to Cover the Forecast Demand for electricity and Ensure the Necessary Reserve in 2023, all of the specified new lines are at the pre-project stages.

Natural gas transportation and storage infrastructure

Given the fact that the transit of natural gas from the territory of the Russian Federation through Ukraine to the EU will most likely stop from 2025, the demand for natural gas within the country will remain, and the potential for exporting natural gas to the EU may also be created for 2025-2030, in relation to the natural gas transportation and storage infrastructure, it is necessary to achieve the following goals:

- ensuring sufficient connections for the transportation of natural gas between Ukraine and the EU/Energy Community;
- modernization (reconstruction) of gas infrastructure facilities to maintain proper technical condition, increase energy efficiency and reduce emissions of harmful substances, as well as optimize the operation of such facilities;
- prospective repurposing of individual gas infrastructure objects for new types of activities within the framework of decarbonization.

1) Sufficient connectivity for gas transmission between the EU/Energy Community/Ukraine.

As of April 2024, the following amounts of capacity are available on international connections with the EU and the Energy Community:

Table 2.9: Capacity of entry/exit points on interstate connections with the EU and the Energy Community

N o	Point name (VIP is a virtual interconnection point; PIP is a physical interconnection point)	Countr y	Entry into Ukraine, million m ³ /day	Output from Ukraine, million m ³ /day	Notes
1	VIP Ukraine-Poland	Poland	6.4	12.9	Entry capacity to Ukraine is currently available as guaranteed on a daily basis and as intermittent conditionally guaranteed - on a quarterly and monthly basis
2	PIP Uzhgorod/Velke Kapushany	Slovakia	0	281	
3	PIP Budince	Slovakia	27	19	In addition, interruptible capacity of 15 million m ³ /day is available at the entry to Ukraine, which can be used for physical gas transportation.
4	VIP Bereg	Hungary	8	48.8	Entry capacity is currently available until 09/30/2024.

5	PIP Isaccea 1/Orlivka 1	Romania	0	19.1	The entry capacity is currently interruptible in the amount of up to 11.5 million m ³ /day. Exit capacity is available in case of capacity reservation at the Kaushany entry point.
6	PIP Ananyiv	Moldova	0	0	
7	PIP Hrebenyky	Moldova	0	36	Entry capacity is currently interruptible in the amount of up to 11 million m ³ /day depending on the season and the possibility of transportation using virtual reverse
8	PIP Kaushany	Moldova	36	12	Capacity is available in case of capacity reservation at the entry and/or exit point Isaccea 1/Orlivka 1 and/or the virtual exit point for border consumers of the Republic of Moldova
9	PIP Oleksiivka	Moldova	0	7.9	Entry capacity is currently interruptible in the amount of up to 1 million m ³ /day depending on the possibility of transportation with the use of virtual reverse
10	Virtual point of exit for border consumers of the Republic of Moldova	Moldova	-	0.85	Capacity available when booking capacity at the Kaushany entry point and/or Isaccea1/Orlivka 1 entry point

Source: LLC "GTS Operator of Ukraine"

The goals for the development of existing connections are stipulated both by Ukraine's international obligations and by separate strategic documents. Thus, according to Article 5, Annex III of Regulation (EU) 2017/1938, adapted in the Energy Community, all cross-border gas pipelines must ensure a constant (guaranteed) bidirectional flow of gas between the Contracting Parties of the Energy Community (i.e. Ukraine and Moldova). At the same time, with regard to existing gas pipelines, by February 1, 2024, GTS operators must submit an application to the relevant state authorities for provision of bidirectional flow or for exemption from this obligation. "GTS Operator GTS of Ukraine" LLC currently does not have the opportunity to obtain the relevant exemption or submit an application, given the fact that the provisions of Regulation (EU) 2017/1938 have not yet been implemented into the legislation of Ukraine, and therefore the Ministry of Energy and the National Energy Regulatory Commission of Ukraine have not yet been empowered to adopt

such decisions. At the same time, according to the preliminary estimates of the GTSO, the demand for capacity from Moldova to Ukraine was identified for PIP Oleksiivka and PIP Hrebenyky during the assessment of market demand for new (increased) capacity (see below). As for PIP Ananyiv and the virtual point of exit to border consumers of the Republic of Moldova, there is no need to create guaranteed capacity in both directions.

In addition, separate strategic documents define some goals in this direction: for example, ESU – increase of guaranteed capacities to ensure the transportation of natural gas with EU strategic partners, and NES – creation of a hub based on Ukrainian gas storage facilities with increased capacity. These goals should be interpreted taking into account market demand.

Thus, the goal of ensuring sufficient interconnection for gas transportation between the EU/Energy Community/Ukraine should be implemented in two directions:

- provision of firm capacity on IPs with the EU/Energy Community, which primarily includes legal confirmation of physically available capacity for long-term booking by customers of transportation services;
- development of new capacity based on market demand analysis.

As of April 2024,¹³¹ capacities to enter Ukraine from Poland, Hungary and Romania are available for booking by customers of transportation services only for limited time periods without the possibility of booking for longer (more than 1 year) periods, even with the presence of the appropriate physical infrastructure. Legal confirmation of physically available capacities as firm is important both for the development of energy markets and for security issues. This issue deserves special attention from the European Commission.

In addition, in accordance with the GTS Code, the GTSO continuously assesses the market demand for capacity increases for IPs. The assessment of potential demand for new (increased) capacity was carried out in July 2023. During the specified period, customers of transportation services had the right to submit non-binding applications. According to the results of non-binding applications received from natural gas market entities, demand for capacity entering Ukraine in two directions was identified: Poland and the Trans-Balkan direction. According to the generalized non-binding applications, the maximum demand for firm capacity from Poland to Ukraine was 9 million m³/day,¹³² from Romania to Ukraine – 18 million m³/day¹³³, from Moldova to Ukraine – 20 million m³/day¹³⁴.

In accordance with CAM NC, as well as in pursuance of the Code of the gas transportation system, approved by the resolution of the National Commission for State Regulation in the Energy and Utilities Sectors of September 30, 2015 No. 2493, registered in the Ministry of Justice on November 6 2015 under No. 1378/27823 (hereinafter referred to as the GTS Code), LLC "GTS Operator of Ukraine" in cooperation with GAZ-SYSTEM held public consultations regarding the increase of capacity on the IP between Poland and Ukraine (consultations lasted until the end of November 2023). The draft proposal for the project of new (increased) capacity between GTS of Poland and GTS of Ukraine¹³⁵ was prepared by GTSOs on the basis of non-binding applications regarding demand, which were received from market participants during the market demand assessment procedure, which was carried out from 03.07-28.08.2023. According to the GTS Code, the next stage of the new (increased) capacity procedure on IPs is the approval and publication of information on the new (increased) capacity procedure.

¹³¹ In the case of Slovakia, the problem concerns additional physically available capacities.

¹³²

¹³³ https://tsoua.com/wp-content/uploads/2023/10/2023_10_23_MDAR_PL-UA_GAZ-SYSTEM_GTSOU_UKR.pdf

¹³⁴ https://tsoua.com/wp-content/uploads/2023/10/2023_10_23_MDAR_UA-RO_UKR.pdf

¹³⁵ https://tsoua.com/wp-content/uploads/2023/10/20231030_Consultation_document_INC-PL_UA_UKR.pdf

In addition, in accordance with the Memorandum on cooperation in the creation of the "Vertical Corridor" signed on January 19, 2024, "Ukraine GTS Operator" LLC, together with the Romanian and Moldovan GTS operators, held public consultations on draft proposals for projects of new (increased) capacity along the Isaccea 1/Orlivka 1 – Kaushany – Hrebenyky route. Joint applications for the approval of projects of new (increased) capacity together with drafts of general rules and conditions to which customers of transportation services must agree in order to gain access to capacity at the mandatory capacity allocation stage of the new (increased) capacity procedure were submitted by the GTSO and operators of the Romanian and Moldovan GTS to the relevant national regulators.



This route already provides for the possibility of transporting gas in the direction of Ukraine even in the absence of gas transit from Russia, as well as increasing this possibility due to minor investments on the part of Ukraine and Moldova (may be carried out until 2028) and taking regulatory measures to encourage the use of this route through entry/exit tariffs from Moldova and Romania.

On April 30, 2024, the NEURC approved draft proposals for increasing the capacity of the GTS at entry points on IPs with Poland, the Republic of Moldova, and Romania. Similar decisions were made by the regulators of the respective neighboring states. Auctions for the allocation of new (increased) capacity should be held in July 2024.

2) Modernization (reconstruction) of gas infrastructure facilities to maintain proper technical condition, increase energy efficiency and reduce emissions of harmful substances, as well as optimize the operation of such facilities.

ESU defines the strategic goal of renewing and modernizing the energy infrastructure according to the best global standards, which includes the optimization of the inactive gas infrastructure and the further efficient operation of its facilities that will remain in operation. In this connection, it is envisaged, in particular, to:

- increase the level of automation of parameter control and management of gas distribution stations;
- reduce the number of technological gas losses;
- optimize the amount of gas distribution stations, taking into account the reduction of consumption;
- replace gas distribution stations with new automatic block-modular ones;
- reconstruct gas distribution stations and priority compressor stations.

In addition, NES provides for the optimization of the capacities and technological parameters of the GTS operation in accordance with the expected load scenarios, as well as the formation and implementation of economically feasible projects for the optimization and modernization of GDS in accordance with the needs of the economy, the implementation of the reconstruction of the inherited networks and the thorough study of gas distribution networks for the possibility of hydrogen transportation.

The National Energy Efficiency Action Plan provides for the implementation of energy efficiency measures in networks. Also, the Plan of measures for the implementation of the climate policy of Ukraine as part of the participation in the global initiative to reduce methane emissions "Global Methane Pledge" foresees a complex task of reducing the volume of methane leaks and emissions during the extraction, processing and transportation of natural gas and oil with credit funds or the funds of international partners.

3) Prospective repurposing of existing gas infrastructure facilities for new activities within the framework of decarbonization.

ESU envisages the implementation of projects aimed at carbon capture and storage (CCUS), which will make it possible to level the existing residual volume of emissions in 2050. In addition, ESU is considering the possibilities of alternative use of the existing infrastructure for the transportation of biomethane, synthetic methane and hydrogen.

In terms of preparation for the transportation of hydrogen, from an infrastructure point of view, in Ukraine, by 2030, it is planned to create a dedicated corridor for its transportation through repurposed or new networks. At the same time, there are no plans for mixing methane gas with hydrogen in the existing gas networks.

At the beginning of 2022, a draft of technical requirements was prepared and pre-agreed with the representation of the European Commission in Ukraine to conduct a general study of the possibility of using Ukraine's GTS for hydrogen transportation with an estimated budget of 3 million euros. In addition, a specialized scientific institution, the Physico-Mechanical Institute named after G.V. Karpenko of the National Academy of Sciences of Ukraine (Lviv), a project of fundamental research into the mechanisms of interaction of hydrogen with pipe steels, their flooding, corrosion and destruction at the micro- and macro-levels, taking into account the state of existing gas pipelines and operational factors (load, environment), is being implemented. The project was launched in May 2023, the planned completion date is June 2024. LLC "Operator GTS of Ukraine" joined the project, providing for research fragments of pipes - those that were in operation (34 years) and analogues from emergency stockpiles.

In addition, in November 2021, a memorandum of understanding was concluded between "GTS Operator of Ukraine" LLC, "Ukrtransgaz" JSC, "Naftogaz of Ukraine" JSC, "Eko-Optima" LLC, RAG Austria AG, Open Grid Europa GmbH, Gas Connect Austria GmbH, Bayerngas GmbH, Eustream as, Nafta as, Bayernets GmbH regarding the launch of the H2EU+Store project, which involves the deployment of hydrogen production and underground storage in Ukraine, the formation of a pipeline corridor from Ukraine through Slovakia and Austria to Germany.

Oil transportation and storage infrastructure

ESU envisages a number of oil infrastructure projects. Their implementation relies on JSC "Ukrtransnafta". The company's plans include both the modernization of the oil transportation system and its development, including with the aim of ensuring the energy security of Ukraine and neighboring countries by diversifying routes for the delivery of oil and oil products through pipelines.

In the context of modernization, JSC "Ukrtransnafta" plans include:

- repair and reconstruction of tank parks, oil pumping stations and the linear part of oil pipelines: automation of technological processes, expansion of IT infrastructure, replacement of equipment, including taking into account energy efficiency requirements;
- control and implementation of measures to reduce greenhouse gas emissions at the facilities of the oil pipeline system;
- decarbonization programs and increasing the energy efficiency of the oil pipeline system.

Two promising projects are aimed at diversifying oil supply sources and routes to attract additional volumes of transportation:

1) the project "Brody - Adamova Zastava":

Until recently, Ukraine could use two ways of oil supply - the Druzhba oil pipeline, which transported oil from Russia, and the Pivdenny marine oil terminal, which supplied oil from the Black Sea. A similar situation existed in Poland, which until recently imported oil through the Druzhba oil pipeline system and through the oil port in Gdańsk on the Baltic Sea.

In connection with the full-scale invasion of the Russian Federation into Ukraine, in June 2022 the Council of the EU adopted the sixth package of sanctions, which prohibits, in particular, the purchase, import or transportation by sea of oil and certain petroleum products from Russia to the EU. The temporary exemption from sanctions applies only to oil imported by pipeline to EU countries, which, due to their geographical location, are particularly dependent on supplies from Russia and have no other real supply options due to insufficient development of the oil transport infrastructure. This benefit is used by Hungary, the Czech Republic, Slovakia and Bulgaria.

A significant limitation of the Russian direction of oil supplies, as well as the constant risk of stopping these supplies opens up wide opportunities for attracting oil from the Caspian region, provided that the appropriate infrastructure is built.

The "Brody - Adamova zastava" project allows to connect the oil transport systems of Ukraine and Poland, while the latter is connected to the oil transport system of Germany. The project envisages the possibility of transporting oil in both directions - both from the Polish port of Gdansk to Ukraine and from the Black Sea ports of Ukraine to Poland and Germany due to the construction of an oil pipeline with a diameter of 700 mm and a length of 396.3 km (125.7 km on the territory of Ukraine and 270.6 km on the territory of Poland). The implementation of the project will allow the transportation of up to 10 million tons of oil per year from the Baltic Sea to Ukraine (or vice versa) at the initial stage, with the possibility of increasing the volume to 20 million tons per year. According to the decision of the Council of Ministers of the Energy Community 2020/04/MC-EnC, the project is included in the list of projects of interest of the Energy Community (PECI).

Map of the "Brody - Adamova Zastava" project



Source: "Sarmatia".

To implement the project, a joint venture MPR "Sarmatia" sp. z o.o.¹³⁶, whose participants are JSC "Ukrtransnafta" (28.78%), the Polish operator PERN (28.78%), the Azerbaijani company SOCAR (25.32%), the Georgian company GOGC (16.10%), the Lithuanian company AB Klaipėdos Nafta (1%). Preparatory works, including marketing research and feasibility study, are actually completed. The project is at the stage of finding a strategic investor, the cost is estimated at 14 million euros (design) and approximately 400 million euros (construction). Provided that there is funding, as well as support at the state level in Ukraine and Poland (in particular, the extension of the Law of the Republic of Poland on the Preparation and Implementation of Strategic Investments in the Oil Sector of February 22, 2019), the project can be implemented in 2-3 years.

2) Implementation of the possibility of transportation of various types of oil (except Urals) through the southern branch of the Druzhba oil pipeline

Currently, the southern branch of the "Druzhba" oil pipeline transports only one type of oil in transit from the territory of the Republic of Belarus. At the same time, in the case of carrying out measures for the transportation of other types of oil, it is possible to use the already existing infrastructure for the transportation of oil from Ukrainian ports to Slovakia, Hungary and the Czech Republic.

No additional investments are required for the implementation of the project. JSC "Ukrtransnafta" already had the experience of transporting oil of various types from the port of Odessa to the Kremenchuk Refinery. At the same time, for the implementation of the project, it is necessary to support it on the part of the recipient countries, both at the governmental and corporate levels. In addition, it is worth noting that the project depends on the possibility of using Ukrainian Black Sea ports for the supply of oil from other countries.

¹³⁶ <https://sarmatia.com.pl/about-us/?lang=en>

Hydrogen transportation and storage infrastructure

NES envisages the regulation of market, regulatory and technical capabilities for the production and export of hydrogen from renewable energy sources and nuclear power plants with a guaranteed price in euros and long-term contracts. ESU defines the task of building an export-oriented energy industry, an element of which is the production and export of hydrogen and alternative gases. According to the project of the Hydrogen Strategy of Ukraine for the period until 2050, it is expected that the production of renewable hydrogen will begin in 2030, simultaneously with the introduction of the Central European Hydrogen Corridor, and export volumes of 0.3-0.4 million tons per year and 1.5-2 million tons will be achieved, respectively, in 2035 and by 2050.

At the same time, it is worth taking into account the criteria for green hydrogen in force in the EU ¹³⁷. So, according to these rules, ¹³⁸ green hydrogen is deemed to be produced from electricity:

1. generated by dedicated capacities not connected to the network or in the case of connection with confirmation that the electricity was not taken from the network;
2. offtaken from the network according to one of four options:

Option A: if the average share of electricity from renewable sources within the trade zone, where the hydrogen production facility is located, is more than 90%;

Option B: if the intensity of emissions of the energy system ("emission intensity of electricity") within the trade zone, where the hydrogen production facility is located, is less than 18 g CO₂-eq./MJ and some other requirements are met;

Option C: if there is concrete confirmation that the electricity used for hydrogen production reduced the need for re-dispatching of renewable generation facilities;

Option D: if the rules on additionality, temporal and geographical correlation are met.

At the same time, the optimal way to transport hydrogen is the subject of ongoing political and scientific debates. It is possible to single out three methods of transportation that are related to the oil and gas infrastructure and may be relevant for Ukraine:

1. transportation through dedicated (or reconstructed) pipelines;
2. transportation by oil infrastructure (in the form of LOHC);
3. transportation by ammonia pipeline.

¹³⁷ Commission Delegated Regulation (EU) 2023/1184 of 10 February 2023 supplementing Directive (EU) 2018/2001 of the European Parliament and of the Council by establishing a Union methodology setting out detailed rules for the production of renewable liquid and gaseous transport fuels of non-biological origin.

¹³⁸ More about these requirements:
https://www.dena.de/fileadmin/dena/Publikationen/PDFs/2023/STUDY_Establishing_a_National_Hydrogen_Standard.pdf

1) Transportation of hydrogen through dedicated (or reconstructed) pipelines.

The Central European Hydrogen Corridor project (abbreviated as CEHC)¹³⁹ is a joint project of the operators of the GTS of Ukraine, Slovakia (Eustream sa), the Czech Republic (NET4GAS sro) and Germany (Open Grid Europe GmbH). The project, which was launched in September 2021, aims to create a pipeline corridor for transporting hydrogen from Ukraine to Germany with a planned capacity of 144 GWh/day, mainly on the basis of existing main gas pipelines. The length of the corridor will be approximately 1,446 km.

In the part that concerns Ukraine, this project is included in TYNDP 2022 as project HYD-N-1137 "Central European Hydrogen Corridor (Ukr part)", which is implemented by LLC "GTS Operator of Ukraine". By decision of the European Commission,¹⁴⁰ this project is included in the list of PCI/PMI as a generic corridor under number 10.4. As part of the project, the Pre-Feasibility Study is being prepared, the deadline for this stage is June 2024.

2) Transportation by oil infrastructure (in the form of LOHC).

The use of oil transport to transport hydrogen over certain distances is currently one of the promising areas of scientific research with the involvement of European companies¹⁴¹. At the EU level, relevant research is often financed by public funds (for example, the UNLOHCKED project (Spain),¹⁴² the SHERLOHCK project (France)¹⁴³, the HYSTOC project (Germany)¹⁴⁴).

JSC "Ukrtransnafta" can be involved in this promising direction of research and possible industrial use of the existing infrastructure for hydrogen transportation.

3) Transportation by ammonia pipeline.

ESU also notes the feasibility of using the "Togliatti-Odesa" ammonia pipeline, which runs through the territory of 6 regions of Ukraine (Kharkiv, Dnipropetrovsk, Zaporizhzhia, Kherson, Mykolaiv, Odesa regions) and branches to the city of Horlivka (Donetsk region), for the transportation of ammonia produced with hydrogen, connecting with the city of Odessa (Odessa port plant). The operator of the ammonia pipeline is the SE "Ukrkhimtransamiak". Currently, the beginning of the ammonia pipeline is in the zone of active hostilities.

¹³⁹ <https://www.cehc.eu>

¹⁴⁰ Commission Delegated Regulation (EU) amending Regulation (EU) No 2022/869 of the European Parliament and of the Council as regards the Union list of projects of common interest and projects of mutual interest, 28.11.2023, C(2023) 7930 final.

¹⁴¹ João Godinho, Ric Hoefnagels, Catarina G. Braz, Ana M. Sousa, José FO Granjo, An economic and greenhouse gas footprint assessment of international maritime transportation of hydrogen using liquid organic hydrogen carriers, Energy, Volume 278, Part A, 2023, 127673, ISSN 0360-5442, <https://doi.org/10.1016/j.energy.2023.127673>.

¹⁴² https://www.clean-hydrogen.europa.eu/projects-repository/unlohcked_en

¹⁴³ <https://cordis.europa.eu/project/id/101007223>

¹⁴⁴ <https://cordis.europa.eu/project/id/779694/factsheet>

ii. Where applicable, main infrastructure projects envisaged other than Projects of Energy Community Interest (PECIs) and Projects of Mutual Interest (PMIs)

Electricity infrastructure

The list and description of the key projects of Ukraine for the development of the electricity transmission system is included in the 2024-2033 Transmission System Development Plan, developed by TSO and approved by the Regulator (NEURC)¹⁴⁵. The projects of technical modernization and development of the transmission system, primarily aimed at increasing system reliability and security of electricity supply by releasing 'blocked' generation capacities, removing internal system restrictions, reducing the level of technological costs of electricity during transmission.

In accordance with the 2022-2031 Transmission System Development Plan, NEC Ukrenergo has developed a comprehensive program of reconstruction, modernization and automation of substations, which provides for the phased reconstruction of all substations of the transmission system, with the introduction of automated control systems. For the first stage of the Program, substations providing power supply to administrative centers and large industrial enterprises were selected. The life time of such substations and their equipment exceeds 35 years, which is beyond the designed operation period. During the selection of reconstruction objects, the development prospects of regional distribution systems, their infrastructure, and environmental and social risks for the population were taken into account. The schedule for the reconstruction of the substations of the first stage is drawn up considering the possibility of ensuring the uninterrupted operation of the UES of Ukraine and without a critical decrease in the reliability of the operation of the nodal substations. The schedule for the automation of substations within the second stage is made taking into account the possibility of removing equipment and the availability of already reconstructed substations in operation. Financing is carried out at the expense of loans of international financial institutions.

Table 2.10. Projects within the framework of the Program of reconstruction, modernization and automation of substations of NEC Ukrenergo (pre-war assessment)

Project name	IFI	Substation	Years of completion
Substation reliability improvement program	EIB	11 SS 330 kV 1 SS 750 kV	2024-2025
Increasing the efficiency of electricity transmission (integration Ukrainian UES to the European system) III	KfW	7 SS 330 kV 1 SS 750 kV	2028
The second electricity transmission project	IBRD	2 SS 220 kV 18 SS 330 kV 1 SS 750 kV	2022-2025
Increasing the efficiency of electricity transmission	KfW	2 SS 330 kV	2025
Reconstruction of substations in the eastern part of Ukraine	KfW	2 SS 330 kV 2 SS 750 kV	2028 ¹⁴⁶
Construction of the 750 kV Rivne NPP - Kyivska substation	EIB	1 SS 330 kV	2024-2025

¹⁴⁵ <https://zakon.rada.gov.ua/rada/show/v2634874-23#Text>

¹⁴⁶ in accordance with the Grant Agreement between KfW and NEC Ukrenergo, concluded on October 13, 2023 p.

The key effects of the implementation of the Program for reconstruction, modernization and automation of TSO substations are as follows:

- increasing the reliability of substations of the transmission system due to the use of modern, economical, highly reliable and environmentally safe equipment, which will ensure the stable operation of substations in compliance with the criteria of network stability and electricity quality indicators;
- replacement of outdated switching equipment, which uses oil and air as an insulating substance, with modern e-legas ones will lead to a 3-5 times decrease in the electricity consumption at substations.
- replacing relay protection and emergency automation devices from electromechanical to microprocessor ones will reduce the electricity consumption of each panel (cabinet) up to 10 times.

In general, a reduction in the consumption of electricity for the substations' own needs is expected at the level of about 30-35%. Also, all air circuit breakers with a voltage of 110-330 kV are planned to be replaced with e-legas ones. The total estimated cost of implementing the Program for improving the reliability of substation equipment, overhead lines, and relay protection devices operated by NEC Ukrenergo is UAH 636.4 million (in 2020 prices).

In order to modernize the electronic communication network and ensure the transmission of information by high-speed streams between the energy facilities of the UES of Ukraine, NEC Ukrenergo in the projects of new construction, reconstruction and technical re-equipment of facilities of the transmission system envisages the development of fiber-optic communication lines. In order to ensure the reliable operation of the UES of Ukraine and the operational security criteria of the transmission system, taking into account the challenges of information security, the UES implements the program for the development of information technologies (through roadmaps with a deadline of 2019-2025 in the following directions: IT solutions for reliable dispatching of the UES of Ukraine, Information security, IT infrastructure and transfer of technological information, Automation of business processes, Service-oriented organization of IT processes).

As part of improving the reliability of the equipment of substations, overhead lines and relay protection devices operated at NEC Ukrenergo, the following programs were approved and are being implemented:

- The program for the phased replacement of potentially dangerous transformers of the TFRM-330, TRN-330 types manufactured by KT "ZZVA" for the period 2021-2025 (the estimated cost of the program is UAH 102.7 million in 2020 prices);
- The program for the phased replacement of defective reinforced concrete supports and lightning protection cable of NEC Ukrenergo for the period 2021-2025 (the estimated cost of the program is UAH 441.8 million in 2020 prices);
- The program for the phased replacement of high-frequency equipment for the transmission of commands and protection posts for the period 2021-2025 (the estimated cost of the program is UAH 91.9 million in 2020 prices).

Oil and gas transport infrastructure (See above in section 2.4.2.i.)

2.4.3. Market integration

The priority direction of the EU energy policy, fixed in the REPowerEU plan, foresees several components that significantly affected the value of gas as an energy resource for the transition to a carbon-neutral economy in 2050. Many EU member states, in particular those that have their own natural gas production and/or are significantly dependent on gas, in their NECPs directly indicate the key role of gas in meeting energy needs in the medium term. This recognition is accompanied by a number of policies and measures related to natural gas and oil, namely:

- increase of own production, including development of continental shelf resources (Romania, Italy);
- new construction, modernization and optimization of infrastructure to increase cross-border flows, including strengthening the capacity of systems within the country (Romania, Italy, Bulgaria).

As a result, in 2030 they predict a significant share of natural gas in meeting energy needs (for example, in Italy - 33-38% from 41% in 2021).

At the same time, other countries set a date for the end of hydrocarbon exploration and development: for example, the Netherlands - in 2040. In both cases, the direction of decarbonization of the oil and gas sector and the understanding of the inevitability of reducing consumption are obvious, in connection with which the following measures are taken:

- establishing specific goals, responsibilities and promoting the development of biomethane and other types of gas from renewable or alternative sources in heat production and transport (France, Italy);
- optimization of gas infrastructure for both transport and storage (Netherlands, France);
- repurposing gas infrastructure for the transportation / storage of hydrogen or carbon dioxide (Netherlands) or implementation of research projects in this direction (Italy).

It is expedient for Ukraine to take these approaches into account during the formation of short- and medium-term energy policy. The presence of significant natural gas production, the largest in the EU, and a wide-ranging system of transportation, storage and distribution of natural gas provides both opportunities and creates additional obstacles on the way to decarbonization in incredibly difficult conditions.

On the one hand, in the period until 2030, Ukraine will be able to satisfy a significant part of its energy needs at the expense of domestically produced natural gas. In addition, a resource may appear for the export of natural gas to the EU. On the other hand, Ukraine should work to reduce natural gas consumption, including in favor of gas and other types of energy from renewable or alternative sources. Thus, policies and measures for the development of the internal market should not only apply to electricity, but also to gas in particular. These policies and measures should generally ensure:

- access of gas consumers to reliable and affordable energy;
- reduction of consumption of all types of energy, including gas;
- increasing the share of gas from renewable or alternative energy sources in the total volume of gas consumption;
- increasing competition in the respective markets and obtaining the benefits of liberalized markets for consumers;
- creating the necessary conditions and providing the correct incentives and signals to the subjects of the natural gas market to prepare for work in the conditions of a decarbonized economy.

i. National objectives related to other aspects of the internal energy market such as increasing system flexibility, in particular related to the promotion of competitively determined electricity prices in line with relevant sectoral law, market integration and coupling, aimed at increasing the tradeable capacity of existing interconnectors, smart grids, aggregation, demand response, storage, distributed generation, mechanisms for dispatching, re-dispatching and curtailment, and real-time price signals, including a timeframe for when the objectives shall be met

Full and comprehensive integration with European energy markets

The ESU includes a strategic goal of full and comprehensive integration of energy markets of Ukraine with European markets by ensuring legal, technical and economic synchronization, which is accompanied by the expansion of trade opportunities between neighboring countries, strengthening of competition and effective functioning of the internal market. At the same time, the development of the export-oriented energy sector is envisaged.

The Law of Ukraine "On the Electricity Market" specifies that regional cooperation should contribute to the harmonization of the regulatory framework and the development of exchanges of electricity between countries, the coordinated allocation of interconnector capacity based on non-discriminatory market decisions, the regional integration of the day-ahead market, balancing and power reserve mechanisms.

It should be noted that such integration is based on the principles of the Treaty on the Establishment of the Energy Community and the Association Agreement with the EU, the main of which are:

- harmonization of Ukrainian legislation with EU energy law acts, both in terms of legislative regulation and law enforcement;
- the movement of energy resources across the borders between Ukraine and the EU without the application of customs duties and other barriers to trade;
- availability of an independent and competent national energy regulator.

As stated above, full and comprehensive integration will require appropriate measures, including from the EU and its member states (in particular, in the context of creating conditions for the imports of renewable gas from Ukraine).

Market-based energy prices for all categories of consumers

NES, among the target indicators within the framework of strategic goal 3 "Ensuring the functioning of free, efficient and competitive markets", defines the goal of market-based pricing for energy carriers for all categories of consumers with the provision of effective mechanisms for supporting vulnerable segments of the population, as well as ensuring the absence of debt burden on energy market participants.

In accordance with the Law of Ukraine "On the Natural Gas Market", the supply of natural gas is carried out at prices freely set between the supplier and the consumer, except for the cases provided for by this Law. The Law of Ukraine "On the Electricity Market" defines the right of traders to buy and sell electricity on the market and to export and import it at freely established prices. Also, the supply of electricity to consumers is carried out at market-based prices, except for the cases established by this Law. Among the principles of the operation of the electricity market, the Law of Ukraine "On the electricity Market" defines non-discriminatory pricing and tariff setting that reflects economically justified costs¹⁴⁷.

Likewise, the ESU is based on the market principle, which provides that the development of the energy sector should be accompanied by competition on the markets and fair pricing.

Smart grids, aggregation, demand-side management, energy storage, distributed generation, dispatching, re-dispatching and curtailments, real-time price signals

According to the 2035 Concept of the implementation of smart grids in Ukraine, the implementation of smart metering in electricity is foreseen during 2022-2035. As part of the eConsumer initiative and with the construction of smart grids, it is planned to ensure 100% commercial metering on energy markets, automatic transmission of consumption readings for processing. As a result, consumers should be provided with the opportunity to manage electricity consumption, reduce energy costs without harming their lifestyle and excessive restrictions on electricity consumption to meet household needs. Also, at the legislative level, the possibility of aggregation is provided (see section 3.4.3.iii of this Plan).

It is planned to reduce the electricity not supplied index by 2030 - at least 3 times¹⁴⁸.

¹⁴⁷ <https://zakon.rada.gov.ua/laws/show/2019-19#Text>

¹⁴⁸ <https://zakon.rada.gov.ua/laws/show/908-2022-%D1%80#Text>

In accordance with the ESU, as a result of the modernization of electric networks, in the long term, it is planned to ensure a reduction in interruptions in the electricity supply according to the SAIDI indicator (average interruption duration index) up to 150 minutes in urban areas and 300 minutes in rural areas.¹⁴⁹

One of the key principles of the ESU is the decentralization of the energy sector - all measures must be implemented taking into account the strategic focus on the development of distributed generation and demand-side management. Among the strategic initiatives and tasks until 2025, the ESU defines the restoration of damaged energy infrastructure facilities with a focus on minimizing GHG emissions by:

- development of RES, which includes a set of measures for the construction of ESS, wind generation and promotion of the development of distributed solar generation to cover own consumption;
- active implementation of energy storage technologies with further expansion of their use.

Among the key tasks of Ukraine's energy sector transformation by 2032, an increase in the share of electricity and heat production from renewable energy sources has been identified. In particular, the share of RES in the structure of electricity generation from 2032 should be more than 25%.

According to the conclusions of the Generation capacity adequacy assessment report, to cover the projected demand for electricity and ensure the necessary reserve in 2023, to increase the flexibility of the energy system, maintain and restore the frequency, by 2030 the energy system will need 0.6 GW of ESS (with total energy capacity of 1.4 GWh) with technical characteristics that meet the requirements of the Transmission System Code - provided that renewable energy sources are involved in balancing the power system and providing reserves. Without the involvement of RES in the regulation or unloading of NPP units in periods of surpluses, the need for ESS in the power system may exceed 2 GW.¹⁵⁰

ii. Where applicable, national objectives related to the non-discriminatory participation of renewable energy, demand response and storage, including via aggregation, in all energy markets, including a timeframe for when the objectives are to be met

Electricity market

The Law of Ukraine "On the Electricity Market" provides for non-discriminatory participation in the electricity market of all participants, in particular in terms of licensing, access to networks and congestion management, allocation of interconnector capacity, tender procedures for attracting new investments in generating capacity, dispatching of the system, purchase of balancing services, pricing and tariff setting, electricity supply, etc. Also, the main tasks of the Regulator in the electricity market include promoting the development of a safe, reliable and efficient operation of the UES of Ukraine, focused on the consumers' needs, which will ensure non-discriminatory access of existing and potential users to the system, adequate capacity and energy efficiency, as well as integration into distribution systems of distributed generation and producers of electricity from alternative energy sources.

¹⁴⁹ The weighted average target according to the SAIDI indicator for urban areas for 2021 was 475 minutes, for rural areas - 958 minutes.

¹⁵⁰ <https://zakon.rada.gov.ua/rada/show/v0664874-23#Text>

Natural gas market

The ESU envisages the task of implementing biomethane production projects and overcoming obstacles to the effective development of such production. In addition, in accordance with the Law of Ukraine "On the Natural Gas Market", the main tasks of NEURC as an energy regulator include, in particular:

- non-discriminatory application of legislation on the natural gas market to biogas or other types of gas from alternative sources; promotion of safe, reliable and economical functioning of gas infrastructure (gas transportation and gas distribution systems, gas storage and LNG installations), which will make it possible to provide opportunities for gas producers from alternative sources to enter the natural gas market, regardless of production volumes;
- provision of simple and unburdening conditions for connection to gas transportation and gas distribution systems for new customer facilities, provision of simple and unburdening conditions for access to gas transportation and gas distribution systems, gas storages and LNG installations for new customers, in particular, removal of barriers that may prevent such access for new wholesalers or suppliers, as well as for wholesalers or suppliers of gas from alternative sources.

The Law of Ukraine "On Alternative Fuels" provides for the main principles of state policy in the field of alternative fuels, in particular, promoting the development and rational use of non-traditional sources and types of energy raw materials for the production (extraction) of alternative fuels with the aim of saving fuel and energy resources and reducing Ukraine's dependence from their import.

ESU also notes the need to take measures to promote the use of biomethane as a motor fuel, adopt European standards for the use of biomethane in the transport sector, and introduce a mechanism to stimulate biomethane production.

iii. Where applicable, national objectives with regard to ensuring that consumers participate in the energy system and benefit from self-generation and new technologies, including smart meters

Electricity market

Ukraine did not set special goals for ensuring the participation of consumers in the operation of the energy system and obtaining benefits from generation for their own needs and new technologies, including smart meters. At the same time, the ESU envisages providing all consumers with the possibility of interaction with all electricity suppliers through the implementation of smart metering, automatic transmission of readings for their processing. Also, the legislation provides for a model of participation of active consumers in the electricity market¹⁵¹ by the mechanism of self-production (net billing) and in other ways¹⁵².

Natural gas market

Ensuring 100% gas metering

¹⁵¹ Active consumer - a consumer, including a private household, an energy cooperative and a consumer who is a customer of an energy service company (ESCO) that consumes and produces electricity, and/or carries out energy storage activities, and/or sells surpluses of produced and/or stored electricity, or participates in energy efficiency and demand-side management activities, provided that these activities are not professional and/or economic activities.

¹⁵² <https://zakon.rada.gov.ua/laws/show/2019-19#Text>

NES envisages the goal of ensuring the installation of meters for gas and the installation of a system of remote metering and automation of natural gas balancing. According to its data, more than 1 million gas consumers do not have individual means of metering, which makes it impossible to monitor gas consumption and does not create incentives for its frugal consumption. Thus, a significant number of household consumers are not even equipped with ordinary meters (according to data for 2021, which are likely to remain relevant).

The corresponding specified goal is established by the Law of Ukraine "On Ensuring Commercial Accounting of Natural Gas", according to which the deadline for equipping all consumers with meters is 01.01.2023. The Verkhovna Rada of Ukraine is considering a bill that provides for the transfer of this term to January 1, 2028.

Reliability and completeness of commercial gas accounting

ESU sets the task of improving the quality of commercial gas accounting.

The system of commercial gas accounting generally serves to determine data on the quality and quantity of gas, which should be used in calculations between gas market participants. Relevant data should be generated on the basis of metered data, but often the latter is not available: it is about situations when the gas meter (metering unit) is missing, when it is faulty, when its readings cannot be promptly transmitted to market entities for mutual settlements.

In general, a large number (but not all) of the problems of commercial gas accounting could be solved by providing 100% metering with the help of meters with the possibility of remote data transmission. However, firstly, making a decision to equip all consumers with the latest means and systems requires a comprehensive assessment of benefits and costs, as well as allocation of funds, and secondly, even with such a decision, its implementation will take a long time. Finally, there may still be situations where meter reading data will not be available.

The commercial accounting system should perform several functions ¹⁵³:

- to clearly identify the subject in whose ownership the volumes of gas were transferred/supplied/used;
- ensure determination of the volume of transferred/supplied/used gas;
- if the data of the metering devices are not available at a certain time, use the replacement data generated in a transparent and justified manner, taking into account the available data of the metering devices in other periods;
- ensure a constant flow of data, its reliability and safe storage, including responding to serious identified discrepancies between the actual volumes and the volumes that were used in the calculations;
- resolve disputes regarding accounting data that may arise between market entities, including taking into account their conflicting interests;

¹⁵³ Problems are observed in Ukraine in all these directions. Since 2015, a large number of legal disputes concern the distribution of supplied/used gas between market entities (GTSO, GDSO, PSO supplier, DHC, "last resort" supplier). For the purposes of commercial balancing, data provided by consumers or determined in a calculated manner are used, while many questions arise regarding the method of calculating these data; most of the data on which the calculations are based are proxy data rather than actual data. As a result of the control reading of meters which should be carried out by the GDSO at least once every 6 months, the relevant commercial accounting data are not adjusted; not all GDSO fulfill their obligation to regularly carry out such control checks. Data on consumption is accumulated at the level of GDSO, while there is a high risk of losing this data, since no state authority determines the requirements for the preservation of this data and the exercise of consumer rights in relation to it.

- to create incentives for the development of competition in the retail gas market (according to Directive 2009/73/EC, consumers must have the right to dispose of data about their consumption by transferring it to a supplier or other persons of their choice).

iv. National objectives with regard to ensuring electricity system adequacy, as well as for the flexibility of the energy system with regard to renewable energy production, including a timeframe for when the objectives are to be met

Electricity market

Ensuring adequacy (sufficiency) of the power system

The ESU predicts that the growth in electricity demand will be covered primarily by carbon-neutral sources (RES and nuclear generation). Since WPP and SPP are non-guaranteed capacity, its balancing in the system will be carried out through:

- flexible capacities of HPPs and HSPs;
- balancing and reserve capacities – thermal power plants on combined fuel (natural gas and/or biomethane) and, in the future, other technologies with similar technical parameters;
- increasing ESS capacities, including long-term (seasonal) storage batteries using the Power-to-X technology (hydrogen, ammonia, etc.).

According to ESU, the total available capacity of power plants in the UES of Ukraine may increase to 62.9 GW by 2032 (NPP - 17.4 GW, CHP - 2.5 GW, WPP - 10.1 GW, SPP - 12.6 GW, HPP – 4.9 GW, HSP – 4.1 GW, TPP – 1.1 GW, bioTES – 0.3 GW, semi-peak and peak generation – 9.4 GW, ESS – 0.5 GW). In particular, it is predicted that the share of nuclear generation will remain at the level of about 56% in the overall electricity production mix in the UES of Ukraine in 2050. The coal-fired generation will be replaced by combined-fuel CHP and TPP plants (natural gas/biomethane) or other technologies with similar characteristics.

Increasing the flexibility of the system

The UES of Ukraine does not have sufficient flexibility and will need its gradual increase to ensure proper integration of power plants with non-guaranteed generation based on RES (solar and wind) into the system in the period up to 2030 and beyond.

According to the conclusions of the 2023 Generation capacity adequacy assessment report, the UES of Ukraine does not meet adequacy requirements, and for the further increase of power plants with non-guaranteed generation based on RES, the problems of ensuring operational security will intensify.

The commissioning of highly flexible capacities with the possibility of quick ramp-up (full activation from a shutdown state and reaching nominal power capacity in 10-15 minutes) and fast-acting reserves based on electricity storage facilities (ESS) will provide an opportunity to provide the UES of Ukraine with the necessary regulatory reserves to meet adequacy requirements in the future.

According to the estimates of NEC Ukrenergo, set out in the 2023 Generation capacity adequacy assessment report,¹⁵⁴ to increase the flexibility of the power system in the near future it is necessary to build:

- at least 1.4 GW of highly flexible generation with quick start (full activation from a shutdown state - no more than 15 minutes, the ability to start and stop at least four times a day with an adjustment range of at least 80% of the installed capacity). In order to maximize the production of electricity from renewables and to reduce its curtailment as much as possible, it is needed to build at least 2.4 GW of highly flexible capacities;

- 0.8 GW ESS (with a total energy capacity of 2 GWh) with technical characteristics that meet the requirements of the Transmission System Code - in case renewables are involved in balancing the power system and providing reserves. Without involvement of renewables in balancing or unloading NPP units in periods of surpluses, the need for ESS in the power system may exceed 2 GW.

Natural gas market

Achieving sufficient volumes of domestic production

NES envisages "providing 100 percent of the needs of the population of Ukraine in natural gas at the expense of own production" as a target indicator for 2030. The ESU sets two tasks - on the one hand, self-sufficiency, and on the other - building an export-oriented energy industry, an element of which is the export of Ukrainian gas to the EU. In this regard, the ESU envisages the export of natural gas as a task until 2050, noting that the forecast of domestic production until 2032 is 21.5 billion m³ in the base scenario, 26.8 billion m³ in the optimistic scenario. In addition, the Law of Ukraine "On the Approval of the Nationwide Program for the Development of the Mineral Resource Base of Ukraine for the Period Until 2030" aims to increase oil and condensate reserves, natural gas to 72.5 million tons and 287.0 billion cubic meters respectively, to 2030 year.

At the same time, the Energy Security Strategy provides among the priority tasks a *reasonable* increase in the production of energy resources within the framework of Strategic Goal 3 "Economic efficiency of the functioning of the energy sector, energy supply systems and import substitution of mineral raw materials."

The increase in natural gas production should be aimed at achieving ESU indicators, while taking into account the need for significant investments necessary for the exploration and development of gas deposits, the possibility of alternative use of funds (in particular, the under-received revenues of the state budget from tax benefits and discounts) and the effect of the "energy efficiency first" principle, as well as prospects for the development of natural gas consumption in Ukraine and the EU.

v. Where applicable, national objectives to protect energy consumers and improve the competitiveness of the retail energy sector

NES includes the goal of forming a market-based price for energy carriers for all categories of consumers, with the provision of effective mechanisms to support vulnerable segments of the population.

One of the principles of the functioning of the natural gas market in accordance with the Law of Ukraine "On the Natural Gas Market" is to ensure a high level of protection of the rights and interests of natural gas consumers, including the provision of the primary interest of natural gas supply security,

in particular, by diversifying sources of natural gas supply. The specified law defines the basic rights of the consumer, in particular the minimum contractual conditions, information that must be placed on payment documents, the right to change the supplier, etc. The main tasks of the Regulator include promoting the achievement of a high level of performance of PSOs in the natural gas market, protecting vulnerable consumers and establishing the data exchange process necessary for consumers to exercise their right to change suppliers.

According to the Law of Ukraine "On the Electricity Market", in order to ensure the protection of consumers' rights, participants in the electricity market cannot apply unfair methods of competition to the consumer. Terms and conditions of contracts with consumers must be transparent and clear. The electricity supply must be carried out on a non-discriminatory basis, and the disconnection of consumers must be carried out exclusively in the manner specified by this Law of Ukraine and the rules of the retail electricity market. Disconnection of protected consumers is carried out in compliance with the requirements of the procedure for ensuring the supply of electricity to protected consumers.

Vulnerable consumers have the right to reimbursement of costs for payment of consumed energy resources in accordance with the Laws of Ukraine "On the Electricity Market" and "On the Natural Gas Market". Additional assistance is provided for the purchase of solid household fuel, namely firewood and coal¹⁵⁵.

At the same time, according to the data of the NEURC, there is significant concentration in the wholesale and retail markets of natural gas. Due to the administrative control of the price for the household consumer, the dynamics of changing the supplier is low. The state of war and energy security challenges have a significant impact on market development.

According to the recommendations of the European Commission ¹⁵⁶, the activity of energy markets should be monitored using the following parameters:

- concentration index (Herfindahl-Hirschman index, HHI);
- comparison of the dynamics of price development in the domestic market and in developed hubs in Europe;
- dynamics of supplier change;
- tariff deficit (the share of uncovered costs for regulated elements of the final price).

Other specific indicators can also be used, the choice of which can be adapted to the specifics of the domestic market ¹⁵⁷. Despite the fact that the NEURC on its own and as part of the Energy Community Regulatory Board often uses relevant indicators, they are not fixed at the state level as goals.

In accordance with the Law of Ukraine "On the NEURC", the NEURC monitors the functioning of markets in the fields of energy and utilities. At the same time, the Procedure for Monitoring Markets in the Energy and Utilities Sectors by NEURC approved by Resolution of the NEURC of September 14, 2017 No. 1120, provides that in the process of market monitoring, an indicator/indicator is determined for each subject of monitoring with an indication (where applicable) of the target (set) values or the permissible range of values, and the target

¹⁵⁵ <https://zakon.rada.gov.ua/laws/show/1173-2023-%D0%BF>

¹⁵⁶ COM(2019) 285 final, 18.06.2019, p.22; SWD(2015) 243 final, 18.11.2015, pp. 32-43.

¹⁵⁷ European Gas Target Model (for the wholesale market); 2017 Handbook for National Energy Regulators: How to assess retail market functioning, Ref: C16-SC-52-03, 24.01.2017 (for the retail market).

(established) values of indicators/indicators are determined by the current legislation and decisions of the NEURC or other state bodies adopted within the limits of the given powers.

It is proposed that by the 1st quarter of 2025, the NEURC will define key indicators and target values of such indicators for the subjects of monitoring (where it is practically possible), which will make it possible to analyze the effectiveness of the policies and measures listed in Section 3.

2.4.4. Energy poverty

Where applicable, national objectives with regard to energy poverty, including a timeframe for when the objectives are to be met In accordance with Regulation (EU) No 347/2013 as adapted and adopted by Ministerial Council Decision 2015/09/MC-EnC.

Reduction of energy poverty, protection of vulnerable consumers, gender and social inclusion is a strategic goal of ESU. It is expected that the transformation of the energy sector will make it possible to significantly reduce the level of energy poverty in Ukraine and to reach and maintain the European average level of 7.9%.

ESU defines energy poverty as a situation when the cost of energy consumed by a household consumer makes up a large part of his income, which leads to his inability to pay for the cost of consumed energy and/or to reduce its consumption and, in turn, negatively affects the quality of life. At the same time, there is currently no such definition in the legislation, as well as quantitative and qualitative indicators, which give reasons to be classified as energy poor.

2.5. Dimension research, innovation and competitiveness

i. National objectives and funding targets for public and, where available, private research and innovation, including, where appropriate, a timeframe for when the objectives are to be met

According to the experts of the International Energy Agency, "accelerating the innovation process is crucial to achieving zero emissions by 2050, and policies in this direction will play a decisive role. Almost half of the emission reductions needed to achieve net zero emissions in 2050 will be provided by technologies that have not yet moved out of the demonstration phase today. This is particularly true for sectors that remain stubbornly dependent on fossil fuels, such as long-distance transport and heavy industry. The goal of achieving zero emissions by 2050 will be unattainable without significant innovation efforts aimed at improving and commercializing known technologies in this decade, as well as bringing less mature ideas to market as soon as possible to minimize the costs of the energy transition"¹⁵⁸.

The key relevant national documents defining priorities in the direction of research, innovation and competitiveness are:

- National economic strategy for the period until 2030¹⁵⁹

¹⁵⁸ Tracking Clean Energy Innovation in the Business Sector: an Overview

<https://www.iea.org/reports/tracking-clean-energy-innovation-in-the-business-sector-an-overview/executive-summary>

¹⁵⁹ "On Amendments to the National Economic Strategy for the Period Until 2030"

<https://zakon.rada.gov.ua/go/202-2021-%D0%BE>

- Strategy for the development of the sphere of innovative activity for the period until 2030 ¹⁶⁰
- Energy strategy of Ukraine for the period until 2050
- Concept of implementation of smart grids in Ukraine by 2035 ¹⁶¹
- Law of Ukraine "On Priority Areas of Science and Technology Development" ¹⁶²
- Law of Ukraine "On Priority Areas of Innovative Activity in Ukraine" ¹⁶³

The priority areas of development of science and technology, as well as innovative activities, fixed at the legislative level were adjusted for the period of martial law. Law of Ukraine of 12/21/2023 No. 3534-IX "On Amendments to Certain Laws of Ukraine Regarding Priority Areas of Development of Science and Technology and Innovative Activities" ¹⁶⁴ defines priorities for the period until December 31 of the year following the termination or abolition of martial law. In particular, among the priority areas of development of science and technology:

- 1) national security and defense;
- 2) fundamental scientific research on the most important problems of scientific-technical, socio-economic, socio-political, human potential development to **ensure Ukraine's competitiveness** in the world and sustainable development of society and the state;
- 3) information and communication technologies;
- 4) **energy and energy efficiency** ;
- 5) rational nature management;
- 6) life sciences, new technologies for the prevention and treatment of the most common diseases;
- 7) **new substances and materials** .

The updated strategic priority areas of innovative activity are defined as:

- 1) technological renewal and development of the spheres of national security and defense;
- 2) **development of new energy transportation technologies, implementation of energy-efficient, resource-saving technologies, development of alternative energy sources** ;
- 3) mastering new technologies **of high-tech development of the transport system** , rocket and space industry, aircraft and shipbuilding, weapons and military equipment;
- 4) **development of new technologies for the production of materials, their processing and connection, creation of the industry of nanomaterials and nanotechnologies** ;

¹⁶⁰ Strategy for the development of the sphere of innovative activity for the period until 2030

<https://zakon.rada.gov.ua/laws/show/526-2019-%D1%80#Text>

¹⁶¹ Concept of implementation of smart grids in Ukraine by 2035 <https://zakon.rada.gov.ua/laws/show/908-2022>

¹⁶² Law of Ukraine "On Priority Areas of Science and Technology Development"

<https://zakon.rada.gov.ua/laws/show/2623-14#Text>

¹⁶³ Law of Ukraine "On Priority Areas of Innovative Activity in Ukraine"

<https://zakon.rada.gov.ua/laws/show/3715-17#Text>

¹⁶⁴ Law of Ukraine "On Amendments to Certain Laws of Ukraine Regarding Priority Areas of Development of Science and Technology and Innovative Activity" <https://zakon.rada.gov.ua/laws/show/3534-20#n6>

- 5) technological renewal and development **of the agro-industrial complex** ;
- 6) introduction of new technologies and equipment for high-quality medical care, treatment, pharmaceuticals;
- 7) **wide application of cleaner production** and environmental protection technologies;
- 8) development of modern information, communication technologies, robotics.

NES contains a number of goals (in the terms of the Strategy - "expected performance result"), for the fulfillment of which:

- It is necessary to use innovative products or high technologies
- State support for the development of innovative projects and innovative activities is needed
- Requires state assistance in one form or another

Among the expected performance results, directly related to innovation and competitiveness are the following:

definition and public support of the state's strategic course in the economic sphere, the consistent implementation of which will enable:

- to prepare **content for business and investment** and restore access to the state;
 - to become **competitive on the international market** ;
 - **to stimulate the development of innovations and the modernization of economic** sectors to ensure the availability of resources on international markets;
 - ensure **the development of human potential** and win **the competition for talents** ;
 - ensure **equal rights and opportunities for women and men** in all spheres of society.
-

The national economic strategy defines the following guidelines, principles and values in economic policy:

- decarbonization of the economy (increasing energy efficiency, development of renewable energy sources, development of circular economy and synchronization with the "European Green Course" initiative);
- development of entrepreneurship, innovation and talent;

The strategy also defines a number of unacceptable steps ("red lines") in particular:

- monopolization of competitive markets;
- unfair use of economic incentives;
- retreat from reforming underdeveloped markets;
- deterioration of the environment.

According to the strategic goal of "Ensuring mutually beneficial trade with the countries of the world and achieving expanded access to foreign markets", the National Economic Strategy, in particular, defines the tasks:

-
- formation of an individual approach in the application of the Carbon Border Adjustment Mechanism (CBAM) to Ukraine as a state that
-

undertook political association and economic integration with the EU within the framework of the Association Agreement between Ukraine and the EU

- agreement with all stakeholders on the revision parameters of Annexes XXX and XXXI to the Association Agreement between Ukraine and the EU (environmental protection environment and climate)
-

Also, NES ¹⁶⁵ provides a wide list of measures aimed at various sectors of the economy, which will require the implementation of research and innovation projects to support the competitiveness of the Ukrainian economy. In particular, the vision of the ICT direction in NES says "Ukraine is [...] a European center for the implementation of research and development works".

The strategic goal of NES **"Creation of new production capacities through stimulation of innovative activities of enterprises in all regions of the country using the competitive advantages of each of them"** among the list of challenges cites such points as:

- high cost and long-term connection of production facilities to the power grid (the cost of connecting to the power grid in Ukraine is several times higher than the cost in EU countries);
- low level of financing of scientific and research works (investment in low-tech production and low costs for scientific and research works);
- lack of close cooperation between scientific institutions and industrial enterprises (detachment of Ukrainian science from the real needs of industry and lack of effective cooperation between science and industry);

The NES also draws attention to the high energy intensity of Ukraine's GDP, but does not offer specific indicators and goals for reducing the energy intensity of the economy:

"High energy intensity and low productivity lead to a decrease in the competitiveness of the Ukrainian processing industry. In 2017, the volume of GDP produced per unit of total primary energy supply in Ukraine reached 5,054 USD, which is close in value to the countries of Eastern Europe, the Caucasus and Central Asia. Although Ukraine is characterized by an annual growth of the created GDP per unit of total primary energy supply (on average by 100-200 US dollars). Poland generates USD 10,620 (twice as much) per 1,000 tons of oil equivalent, and in EU countries the average figure is 2.53 times higher (USD 12,802) than in Ukraine"

NES assigns a significant role to the energy sector, in particular, it fixes important from the point of view of research, innovation and competitiveness the ways of achieving the strategic goal "Ensuring the operation of a smart, modernized and reliable energy system that fully meets the requirements and needs of end users":

Ways of achievement strategic goal	Task
1. Modernization and optimization of capacity operation	[...] • Regulation of the work of distributed generation aggregators and balancing service providers • [...]

¹⁶⁵ "On Amendments to the National Economic Strategy for the Period Until 2030"
<https://zakon.rada.gov.ua/go/202-2021-%D0%BF>

Ways of achievement strategic goal	Task
	• Ensuring the increase in the volume of storage capacities of energy storage — a battery system for storing electrical energy • Consideration of the possibility of hydrogen production using excess electricity in the system with the aim of further exporting hydrogen to the EU • Regulation of the operation of localized generation from renewable energy sources, which is connected directly to the consumer's networks, without payment for the distribution and transmission of electricity [...]

2. Promotion of infrastructure development

- Support for the reconstruction and development of distribution networks in accordance with the development of distributed electricity generation
- Formation and implementation of economically feasible projects for the optimization and modernization of gas distribution networks in accordance with the needs of the economy, the implementation of the reconstruction of the necessary outdated networks and the preparation of gas distribution networks for the transportation of hydrogen
- [...]
- The release of closed capacities as a result of the implementation of the program for the development of power networks and the implementation of projects aimed at removing internal restrictions
- Providing a clear definition of the purpose and limits of the use of the small distribution system
- [...]
- Consideration of the issue of infrastructure formation to ensure Ukraine's integration into the hydrogen economy
- [...]
- Support for the reconstruction and development of distribution networks in accordance with the development of distributed electricity generation

As part of the ways to achieve the strategic goal of "Increasing the energy efficiency of the economy and ensuring the environmental sustainability of the energy sector", the following tasks are foreseen:

Ensuring sustainable development	• Stimulation of scientific organizations for research in the field of energy efficiency and hydrogen technologies • Regulation of market, regulatory and technical opportunities for the production and export transfer of hydrogen from renewable energy sources and nuclear power plants with a guaranteed price in euros and long-term contracts

In the NES, the strategic goal of "Strengthening the competitiveness of industrial products produced in Ukraine, introduction of resource- and energy-efficient technologies", in particular, indicates one of the ways to achieve the strategic goal of increasing resource efficiency with the following tasks:

Increasing resource efficiency	• increasing the level of awareness about the introduction of resource-efficient technologies • implementation of effective regulation in the field of resource conservation and use of renewable energy sources • attraction of grants and loans for resource-saving and energy-saving technologies • providing access to high-quality energy audits
	• ensuring the implementation of energy management systems • the development of sustainable public procurement by increasing the level of awareness of market participants and methodological support regarding the application of sustainability criteria • introduction of a system of tax incentives for eco-modernization • implementation of the system of trading quotas for greenhouse gas emissions and other tools for setting the price for greenhouse gas emissions • implementation of the best available technologies and management methods

Also, the above strategic goal provides for stimulating the development of the circular economy with the corresponding tasks:

Stimulating the development of the circular economy	• creation of transparent and competitive markets for secondary raw materials by improving and harmonizing the legislation of Ukraine with the relevant legislation and EU norms and rules • stimulating the reduction of waste generation volumes • simplification of the procedure for carrying out operations with scrap metal • formation of circular economy policy • introduction of the extended producer responsibility system • implementation of a set of measures for the commercial development of industrial waste

Another strategic goal relevant for NECP within the framework of NES is goal 4 "Creation of new production capacities by stimulating innovative activities of enterprises in all regions of the country using the competitive advantages of each of them", which refers to the ways of achieving the implementation of innovative technologies with the following tasks:

Implementation of innovative technologies	• creation of a platform for sharing experience in the implementation of innovative technologies • improvement of the mechanism of commercialization of scientific and technical developments, scientific and research works • reducing the risk of implementation of innovative projects through insurance tools for such projects • creation of favorable conditions for the development of clusters • formation of mutual relations and strengthening of cooperation between institutions of higher education, scientific centers and industry • integration of industrial clusters of Ukraine with the European platform of cluster cooperation • creation of scientific and technical clusters with the participation of basic enterprises • implementation of the best available technologies in accordance with EU Best Available Techniques reference documents (European reference documents)

Also, within the framework of goal 4, a significant role is assigned to Industry 4.0 and relevant research and innovation projects:

Implementation of Industry 4.0	• popularization of the concept "Industry 4.0" and its individual elements as a mandatory factor for increasing the competitiveness of industrial enterprises on international markets • institutionalization of Industry 4.0 — strategy synchronization

	• involvement of industrial companies in the introduction of the concept of "Industry 4.0" at the expense of EU funds, in particular, under the Framework Program of the European Union for Research and Innovation "Horizon Europe" (2021-2027) • facilitating the implementation of educational activities on the transfer of best practices from the IT sector to industrial sectors • ensuring the integration of innovations in the field of Industry 4.0 in the strategy of the country's defense complex and security • formation of new competencies of personnel in industry with the aim of introducing digital technologies • full-scale digitization of key industrial sectors • ensuring clustering in the field of Industry 4.0 — at the national and regional level

The strategic policy course in the field of development of the agro-industrial sector, defined in the NES, provides for several ways of achieving the strategic goal of "Ensuring stimulating and advisory agrarian policy", which are relevant to the issue of NECP:

State policy in the agro-industrial sector regarding environmental protection and management of natural resources in agriculture	• approximation of national legislation, standards and practices to the pan-European principles of sustainable agriculture policy and proper agricultural practices, gradual alignment of state agrarian policy with the EU Green Deal in agriculture • development and monitoring of indicators of the impact of agricultural activity on the state of ecosystems • development, promotion of implementation and introduction of monitoring of compliance with minimum environmental standards • introduction of a national report on the level of greenhouse gas emissions during the production and circulation of agricultural crops • introduction of economic stimulation measures for the use and protection of land and increasing soil fertility, reducing the level of pollution of water and other environmental components from agricultural sources, improving the structure of the country's lands and lands, restoring anthropogenically altered ecosystems, implementing sustainable land use and achieving a neutral level of land degradation

Magnification manufacturability in monitoring the quality of land resources	• systematic monitoring of soil fertility indicators and their quality, introduction of satellite monitoring • reforming the system of state research institutions, improving the quality and efficiency of scientific support for the agro-industrial complex, expanding the conduct of scientific research relevant to agricultural producers, strengthening innovation potential, deepening the integration of domestic scientific institutions into the international research community • ensuring the adjustment of crop cultivation technologies taking into account the results of navigation with the global system positioning and agricultural machinery

The strategic goal of the NES "Balancing the production of high- and low-margin products to increase the profitability of the [agricultural] sector" provides for:

Ensuring the development of sustainable production	• promotion of sustainable agricultural production, protection of the natural environment and animals, spread of organic production methods and the use of biotechnology, " climate-smart " agriculture and forestry with reduction of greenhouse gas emissions and adaptation to climate change , sustainable management of natural resources resources and preservation and increase of biodiversity

The strategy for the development of the sphere of innovative activity of Ukraine for the period until 2030 does not single out low-carbon sectors and technologies as one of the priority areas, but it refers to the Strategy for low-carbon development until 2050 as one of about 40 strategic documents at the industry level, relating to the development of innovations in one or another sphere ¹⁶⁶ . At the same time, attention should be paid to the status of this document, which was supported and approved by the protocol decision of the Cabinet of Ministers of Ukraine on July 18, 2018 ¹⁶⁷ and published on the UNFCCC website ¹⁶⁸ , but is not in the databases of official documents of state bodies of Ukraine. Resolution of the Verkhovna Rada of Ukraine of November 5, 2021 No. 1870 "On the Appeal of the Verkhovna Rada of Ukraine to the United Nations Conference on Climate Change, which will include the holding of the 26th session of the Conference of the Parties to the United Nations Framework Convention on Climate Change, 16 of the Conference of the Parties, which is a meeting of the Parties to the Kyoto Protocol, and the 3rd session of the Conference of the Parties, which is a meeting of the Parties to the Paris Agreement, the UN General Assembly, the European Union, the Council of Europe, parliamentary assemblies, the European Parliament, the Inter-Parliamentary Union, other regional and international organizations, governments and parliaments of foreign countries, in support of global goals on climate change" ¹⁶⁹ , in particular, the Cabinet of Ministers of Ukraine was instructed to develop and submit to the Verkhovna Rada of Ukraine for consideration the draft Law of Ukraine "On the strategy of low-carbon development of Ukraine for the period until 2050".

Among the program measures aimed at solving the problems of innovative activity in Ukraine, the Strategy of the sphere of innovative activity calls for a review of the priority directions of the development of science and technology with the aim of bringing them closer to the directions determined in the developed countries of the world, based on modern global technological trends.

Considering the extremely high priority of research in the climate sphere and the sphere of low-carbon technologies in most of the highly developed countries of the world, this tangentially confirms the trend towards the development of low-carbon technologies in the Ukrainian scientific and innovative sphere.

Also, the program activities of the Strategy for the Development of the Sphere of Innovation include the creation with the involvement of global experts, trainers, mentors, the European Entrepreneurship Network (EEN) of schools for the exchange of experience and national resources for teaching entrepreneurship and innovation, in particular, networks of professional development for both teachers and managers institutions of higher education and scientific institutions.

One of the most transformative factors for the entire Ukrainian economy and for the industry of low-carbon technologies in particular, the Strategy for the Development of the Sphere of Innovative Activity calls the introduction of European technical standards in Ukraine, stipulated by the Association Agreement between Ukraine and the EU.

Among the indicators of the implementation of the Strategy for the Development of the Innovative Activity of Ukraine (base year - 2017):

¹⁶⁶ "On the approval of the Strategy for the development of the sphere of innovative activity for the period until 2030" <https://zakon.rada.gov.ua/go/526-2019-%D1%80>.

¹⁶⁷

<https://mepr.gov.ua/diyalnist/napryamky/zmina-klimatu/pom-yakshennya-zminy-klimatu/strategiya-nyzkovuglets-evogo-rozvytku-ukrayiny-do-2050-roku/>

¹⁶⁸ https://unfccc.int/sites/default/files/resource/Ukraine_LEDS_en.pdf

¹⁶⁹ <https://zakon.rada.gov.ua/laws/show/1870-IX#Text>

- the share of expenses for the performance of **scientific and scientific and technical works in the gross domestic product - 3%** (in 2017 - 0.45%);
- the share of **innovative enterprises** in the total number of enterprises - **at least 30%** (in 2017 - 16.2%);
- the share of **exports of goods produced by enterprises of high- and medium-tech sectors of industry** in the total volume of exports of goods - **30%** (in 2017 - 15.4%);
- the share of **workers** employed at enterprises belonging to **the high- and medium-tech sectors of industry** in the total number of employed workers in industry - **29%** (in 2017 - 21.3%);
- the share of sold **innovative products** in the total volume of sold industrial products - **10%** (in 2017 - 0.7%).

Action plan for the years 2021-2023 for the implementation of the Strategy for the development of the sphere of innovative activity for the period until 2030, approved by the order of the Cabinet of Ministers of Ukraine of December 9, 2021 No. 1687 (Official Gazette of Ukraine, 2022 p., No. 1, Article 6), provides several important steps for the low-carbon technology sector:

Promoting the development of a network of Industry 4.0 centers (Ministry of Economy, MES, Ministry of Infrastructure, Ministry of Digital, Ministry of Strategy and Industry, industry and business associations (upon agreement))

Expected result:

- the competences and capabilities of Industry 4.0 centers have been expanded, the cooperation of such centers with the network of Digital Innovation Hubs (DIHs) is carried out

Development of a network of technology and innovation support centers with the assistance of the World Intellectual Property Organization (Ministry of Economy, Ministry of Education, Culture, Sports, Science and Technology, Ukrpatent (with consent))

Expected result:

- technology and innovation support centers were established in all regions
- subjects of innovative activity have access to the patent database and receive basic consulting services

Providing financial support to institutions of higher education and scientific institutions for the implementation of innovative activities (MES)

Expected result:

- institutions of higher education and scientific institutions receive financial support for innovative activities based on the results of the competitive selection of scientific, scientific and technical works and projects, which are financed at the expense of the external aid instrument of the European Union for the fulfillment of Ukraine's obligations in the Framework Program of the European Union for Scientific Research and Innovation "Horizon 2020"

Ensuring the implementation of information campaigns regarding the possibility of participation in domestic competitions and international innovation programs, regarding the success stories of the implementation of innovative activities (Ministry of Education, Science and Technology, Ministry of Statistics, Ministry of Economy, Ministry of Infrastructure)

Expected result:

- the level of awareness of innovators regarding the possibilities of participation in domestic competitions and international programs, as well as the success stories of the implementation of innovative activities, has been increased

- held information days for innovators to inform about the possibility of participation in the European Union Framework Program for Research and Innovation "Horizon Europe" in terms of innovation support
- held information days for innovators to inform about the possibility of participation in the "EUREKA" program

The energy strategy of Ukraine for the period up to 2050 sets among its strategic goals the target indicator **"The energy intensity of the GDP has been reduced by 50 percent due to the effective policy of using energy resources . "**

In assumptions about the energy intensity of individual industries, the ESU focuses on the indicators listed below:

- Mining industry: 21% reduction in energy intensity by 2032 compared to 2023.
- Manufacturing: the main changes will concern the sectors of metallurgy (reduction of energy intensity by 51% by 2050) and engineering (reduction of 50%), while gas consumption will decrease due to hydrogen substitution.
- Services sector: the transition to the use of RES, natural gas and electricity will reduce specific energy consumption by 22% by 2032 and by half by 2050 (compared to 2023).

The concept of the implementation of smart grids in Ukraine until 2035, which was approved by the order of the Cabinet of Ministers of Ukraine of October 14, 2022 No. 908 (Official Gazette of Ukraine, 2022, No. 84, Article 5201), is a document that establishes the obligations State responsibility in the field of implementation of smart grids. And despite the fact that the word "innovation" is used only 1 time in this document, the entire Concept is devoted to the implementation of a set of technologies that are innovative in nature. An important feature of this document is that it pays considerable attention to:

- work on changing the legislation in order to facilitate the implementation of "smart grid" technologies;
- coordination between various authorities (Ministry of Energy, Ministry of Statistics, Ministry of Economy, MES, Ministry of Justice, NEURC, Dezhspetsvyazo) to improve the regulatory field, which will contribute to the creation of smart grids;
- involvement of private and public stakeholders in organizational activities aimed at promoting smart grids in Ukraine

The purpose of the Concept is to "determine directions and tasks, as well as ensure coordination of actions for the implementation of smart grids taking into account existing and planned state and regional programs for the development and modernization of the energy sector."

The Concept notes that measures for the implementation of smart grids require significant funding, however, the Concept notes that the financing of the measures provided for in the document should be carried out at the expense of:

- inclusion of measures for the implementation of smart grids in the investment programs of regulated companies (distribution system operators, transmission system operators, electricity producers; other sources not prohibited by law);
- attraction of funds from donors and international financial institutions

An appendix to the Concept is the "Plan of measures for the implementation of the Concept of the implementation of smart grids in Ukraine until 2035", which provides for the sequential implementation of 33 specific interrelated measures during the years 2022-2035. Among the measures, both normative, organizational and technical measures are indicated measures, regarding the measures, the time of their implementation is indicated and, responsible state authorities, the expected results of the implementation of the measures are determined.

ii. *Where available, national 2050 objectives related to the promotion of clean energy technologies and, where appropriate, national objectives, including long-term targets (2050) for deployment of low-carbon technologies, including for decarbonising energy and carbon-intensive industrial sectors and, where applicable, for related carbon transport and storage infrastructure*

See above in section 2.5.i. of this Plan, in particular in the part of individual indicators of the Energy Strategy of Ukraine for the period until 2050.

iii. *Where applicable, national objectives with regard to competitiveness*

See above in section 2.5.i.

3. POLICIES AND MEASURES

3.1. Dimension decarbonisation

3.1.1. GHG emissions and removals

i. *Policies and measures to achieve the economy-wide target covering all key emitting sectors and sectors for the enhancement of removals, with an outlook to the long-term vision and goal to become a low emission economy and achieving a balance between emissions and removals in accordance with the Paris Agreement*

Cross-sectoral policies and measures

PM_D_WEM_01 Environmental tax levied on carbon dioxide emissions

Objective: Stimulating the reduction of carbon dioxide emissions (in millions tons of CO₂), tax revenue generation for the state budget (millions of UAH).

Legal basis: Tax Code of Ukraine, Budget Code of Ukraine

Time frame: since 2010

Responsible bodies/organizations: Ministry of Environment, Ministry of Finance, State Tax Service, SAEE

Description: Environmental tax levied on carbon dioxide emissions in Ukraine was introduced in 2010 with the approval of the new Tax Code of Ukraine. The tax is levied on emissions of carbon dioxide into the atmosphere by stationary sources of pollution. Entities that emit CO₂ in the amount of no more than 500 tons per year are exempted from the CO₂ tax. In case of exceeding this amount, the entities are obliged to register as taxpayers in the tax (reporting) period, prepare and submit tax reports, calculate and pay tax for the tax (reporting) period. For entities whose annual emissions exceed 500 tons, the tax base is reduced by the amount of such emissions in the amount of 500 tons per year based on the results of the tax (reporting) year.

At first, the tax rate was only 0.2 hryvnias per 1 ton of emissions and was gradually increased until 2018. In 2019, the tax rate was increased more than 24 times – from UAH 0.41/t to UAH 10/t, and in 2022 – another 3 times. As of 2024, the tax rate is UAH 30/t. It is expected that the tax rate will continue to increase.

With the increase in the tax rate, tax revenues to the state budget gradually increased as well. Thus, in 2021, the tax brought 1.2 billion UAH to the state budget¹⁷⁰. Although the tax rate was increased 3 times from 2022, tax revenues increased by only 25% to UAH 1.5 billion, which is due to a significant decline in industrial production due to the full-scale invasion of the Russian Federation into Ukraine.

¹⁷⁰ <https://openbudget.gov.ua/national-budget/incomes>

The Tax Code of Ukraine stipulates that at least 70% of the proceeds from the payment of the environmental tax for carbon dioxide emissions must be directed to measures that lead to the reduction of emissions (decarbonization) by industries classified in section C "Processing industry" and section D "Supply of electricity, gas, steam and conditioned air" of the National Classifier of Ukraine "Classification of types of economic activity" DK 009:2010¹⁷¹, in line with procedures defined by the Budget Code of Ukraine. At the same time, the Budget Code of Ukraine provides for the establishment of the State Fund for Decarbonization and Energy-Efficient Transformation from January 1, 2024, and envisions that at least 70% of the carbon tax revenue is earmarked as a funding source for the Decarbonisation Fund (for details, see section 3.2 of this Plan, PM_EE_WEM_02).

The Ministry of Environment, together with the Ministry of Finance, is developing a reform of the environmental tax levied on carbon dioxide emissions. In particular, the National Revenue Strategy until 2030, approved by the Decree of the Cabinet of Ministers of Ukraine of December 27, 2023 No. 1218 (Official Gazette of Ukraine, 2024 p., No. 11, Article 722)¹⁷², provides that during 2024-2025 there should be a model of the transition from taxation of the actual amount of carbon dioxide emissions to taxation of the amount of production (import) of fossil fuels (oil, gas, coal, etc.), depending on the content of carbon, and the schedule for the introduction of changes to environmental and tax legislation has also been determined.

In addition, the Verkhovna Rada of Ukraine has registered a draft Law of Ukraine "On Amendments to the Tax Code of Ukraine regarding the establishment of a zero hryvnia environmental tax rate for carbon dioxide emissions for installations that produce such emissions as a result of burning biofuel" (reg. No. 9596 of 09.08. 2023)¹⁷³ and the draft of the Law of Ukraine "On Amendments to the Law of Ukraine "On Alternative Fuels" Regarding the Establishment of the Register of Installations Using Biofuel as the Only Type of Fuel" (Reg. No. 9597 of 09.08.2023), which provide for exemption from payment of environmental a tax on carbon dioxide emissions of installations burning biofuels and the establishment of a register of installations using biofuels as the only type of fuel to ensure the administration of the zero tax rate. The adoption of these draft laws will allow Ukraine to apply widely used practices regarding the development of the use of biofuels for energy production and reduce the tax burden on bioenergy facilities, which will facilitate their development.

PM_D_WAM_01 National Emission Reduction Plan from Large Combustion Plants

Objective: Gradual reduction of emissions (in million tons) of sulfur dioxide, nitrogen oxides and substances in the form of suspended solid particles, undifferentiated by composition, from existing large combustion plants, the nominal thermal power of which is 50 MW and more, and the first emission permit or permit for installation design was issued until July 1, 1992; enforcement of Directive 2010/75/EC on industrial emissions.

Legal basis: Decree of the Cabinet of Ministers of Ukraine of November 8, 2017 No. 796 "On the National Plan for Reducing Emissions from Large Combustion Plants (Government Courier, 2017, No. 226)

Time frame: from 2017

Responsible bodies/organizations: Ministry of Energy

Description: The Government approved the National Emission Reduction Plan from Large Combustion Plants (hereinafter NERP) (Government Courier, 2017, No. 226)¹⁷⁴ on November 8, 2017 in order to fulfill Ukraine's obligations under the Treaty on the Establishment of the Energy Community in particular reducing emissions of pollutants. The Ministry of Energy is designated as the coordinator of the implementation of the mentioned National Plan.

¹⁷¹ <https://zakon.rada.gov.ua/rada/show/vb457609-10#Text>

¹⁷² https://www.mof.gov.ua/storage/files/National%20Revenue%20Strategy_2030_.pdf

¹⁷³ <https://itd.rada.gov.ua/billInfo/Bills/Card/42483>

¹⁷⁴ <https://zakon.rada.gov.ua/laws/show/796-2017-%D1%80#Text>

Although the NERP is directly aimed at reducing air pollution, and not at reducing GHG emissions, the implementation of the NERP will indirectly contribute to the reduction of GHG emissions due to the reduction in the operation of thermal generation facilities. Thus, in Appendix 4 to the NERP, there is a list of installations that must be closed after a certain limit of working hours has been reached. Also, all other installations from Annex 2 to the National Plan, which have not been ecologically modernized in accordance with the requirements of Directive 2010/75/EU on industrial emissions, are subject to decommissioning. In addition, sulfur dioxide and nitrogen oxides are precursors of GHG, that is, they contribute to the formation of GHG under the influence of certain factors. Accordingly, reducing emissions of sulfur dioxide and nitrogen oxides will have an additional positive impact on GHG emissions reduction.

During 2024-25, it is planned to develop a normative act on determining the procedure and sources of funding for environmental protection measures provided for by the NERP, as well as approval of schedules for the reconstruction and closure of power units (with the possibility of revision depending on the consequences of the war).

PM_D_WAM_02 National GHG Emissions Trading System

Objective: Stimulating the reduction of greenhouse gas emissions (in million tons of CO₂-eq.)

Legal basis: the Law of Ukraine "On Principles of Monitoring, Reporting and Verification of Greenhouse Gas Emissions", draft Strategy for the Implementation of the National GHG Emissions Trading System for the Period Until 2033

Time frame: from 2026

Responsible bodies/organizations: Ministry of Environment

Description: Ukraine undertook the commitment on the implementation of Directive No. 2003/87/EU establishing a scheme for greenhouse gas emission allowance trading within the Community when it signed and ratified the Association Agreement between Ukraine, on the one hand, and the European Union, the European Community of Atomic Energy and their member states, on the other hand, in 2014. The first step to establish a National GHG Emissions Trading System (hereinafter - ETS) was the adoption of the Law of Ukraine "On Principles of Monitoring, Reporting and Verification of Greenhouse Gas Emissions" ¹⁷⁵ (hereinafter MRV) in 2019 and by-laws that allowed the MRV system to be fully launched from 2021. Before the full-scale invasion of the Russian Federation into Ukraine, there were more than a thousand of installations that should have been covered by the Ministry of Foreign Affairs. According to the preliminary estimates of the Ministry of Environment, the number of such installations decreased by 40% due to the destruction by the Russian invaders of industrial facilities in the territories of Donetsk and Luhansk regions and in other regions of Ukraine. The registration of installations in the MRV system continues even during the full-scale invasion of the Russian Federation into Ukraine. However, the functioning of the MRV system is currently limited. This is due to the fact that the submission of reports and other documents, which is required in accordance with the norms of current legislation in paper and/or electronic form, is voluntary during the period of martial law or a state of war in accordance with the provisions of the Law of Ukraine "On the Protection of Interests of Subjects Submitting Reports and Other Documents During the Period of Martial Law or a State of War".

In June 2024, the Ministry of Environment released for public discussion the Strategy for the Implementation of the National GHG Emissions Trading System until 2033.

¹⁷⁵ <https://zakon.rada.gov.ua/laws/show/377-20#Text>

Taking into account the experience of the EU ETS, the draft Strategy assumes that the implementation of the ETS will be carried out during the following three stages until 2033:

- preparatory stage - 2024-2025. This stage of the implementation of ETS in Ukraine involves the development and adoption of the relevant law and other regulatory acts, the establishment of new or expansion of the functional responsibilities of existing institutions that will support ETS, and the implementation of appropriate administrative procedures, improvement of the technical infrastructure for monitoring, reporting and verification of emissions of greenhouse gases, promoting the interaction and raising awareness of market participants, as well as organizing training and providing support to relevant institutions and stakeholders involved in the process of implementing the ETS.
- the pilot stage of the operation of the ETS in Ukraine (hereinafter - the pilot stage) - 2026-2028. The purpose of the pilot stage of the implementation of the ETS is to check the effectiveness, capabilities and readiness of this system in Ukraine, taking into account the national circumstances. This stage is aimed at identifying and solving any potential challenges, improving regulatory mechanisms, improving the qualifications of market participants, and preparing for the full functioning of the ETS.
- the first stage of full functioning of the ETS in Ukraine (hereinafter referred to as the first stage) - 2029-2033. This stage is aimed at the establishment of a reliable market system, strengthening regulatory control and improving relevant oversight (control) mechanisms, facilitating the integration of additional sectors into the ETS, ensuring accession or connection to the EU ETS and continuing efforts to increase the capacity to support the carbon market to achieve a sustainable development and climate stability.

The draft operational plan for the implementation of the Strategy in 2024-2026 includes 18 tasks, the implementation of which should ensure the launch and effective functioning of the STS. In particular, in 2024, it is planned to develop and agree with interested parties on substantiated proposals regarding the structure and parameters of the key components of the ETS in Ukraine, which take into account national circumstances and are harmonized with the Directive of the European Parliament and the Council No. 2003/87/EC of October 13, 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC (hereinafter - Directive 2003/87/EC) and relevant European delegated rules, implementing acts, regulations. The development and adoption of the draft Law on the ETS is planned for 2024-2025.

PM_D_WAM_03 Action plan for the implementation of Ukraine's climate policy within the framework of participation in the global initiative to reduce methane emissions "Global Methane Pledge"

Objective: Stimulating the reduction of methane emissions (in million tons)

Legal basis: Order of the Cabinet of Ministers of Ukraine of July 7, 2023 No. 607 "On the approval of the plan of measures for the implementation of Ukraine's climate policy within the framework of participation in the global initiative to reduce methane emissions "Global Methane Pledge"" (Official Gazette of Ukraine, 2023 p., No. 67, Article 3842)

Time frames: 2023-2030

Responsible bodies/organizations: Ministry of Environment, Ministry of Energy

Description: To fulfill Ukraine's obligations within the framework of participation in the global initiative to reduce methane emissions "Global Methane Pledge", the Government developed and approved the Action Plan on July 7, 2023 ¹⁷⁶.

¹⁷⁶ <https://zakon.rada.gov.ua/laws/show/607-2023-%D1%80#Text>

The plan envisages the implementation of 23 measures by 2030 in the sectors of extraction, processing and transportation of natural gas and oil, coal mining, waste management and agriculture. As an example, some of the most significant activities in the oil and gas sector are presented in Table 3.1 below. Implementation of the plan is expected to reduce methane emissions by 30% by 2030 from 2020 levels.

Table 3.1. Selected measures to reduce methane emissions in the oil and gas sector

Name of the event	Responsible for implementation	Term of execution, years	Sources of funding
Conducting a full tracking of the volume of methane leaks during extraction, processing and transportation of natural gas and oil	Ministry of Energy, Ministry of Environment, JSC "Naftogaz of Ukraine" (with consent), LLC "Operator GTS of Ukraine" (with consent)	2023-2024	loans from international financial organizations; other sources of funding, which are not prohibited by the law
Implementation of effective accounting of methane leaks at energy sector enterprises in accordance with the OGMP 2.0 initiative	Ministry of Energy, Ministry of Environment, JSC "Naftogaz of Ukraine" (with consent), LLC "Operator GTS of Ukraine" (with consent)	2023-2030	loans from international financial organizations; other sources of funding, which are not prohibited by the law
Development and approval of a sectoral action plan for the reduction of methane leaks and the provision of such measures in investment programs at state-owned enterprises in the oil and gas sector	Ministry of Energy, Ministry of Environment, JSC "Naftogaz of Ukraine" (with consent), LLC "Operator GTS of Ukraine" (with consent)	2023-2030	loans from international financial organizations, including under the framework of financing the post-war reconstruction and development of Ukraine; other sources of funding, which are not prohibited by the law
Development and approval of the requirements for the operator of the gas transportation system and operators of gas distribution systems regarding regular practices for detection and elimination of leaks from gas networks (LDAR)	Ministry of Energy, NEURC (with consent), LLC "Operator GTS of Ukraine" (with consent), JSC "Naftogaz of Ukraine" (with consent)	2023	loans from international financial organizations; other sources of funding, which are not prohibited by the law

Policies and measures to reduce GHG emissions in the transport sector

To stimulate the reduction of GHG emissions in the transport sector, a number of measures are envisaged for the development of the use of RES (PM_D_WAM_15), electrification (PM_D_WEM_08, PM_D_WEM_09) and the transition of municipal transport to low-carbon alternatives (PM_D_WEM_10).

Policies and measures to reduce GHG emissions in the agriculture

PM_D_WAM_04 Promoting the development of organic crop production

Objective: stimulating the increase of areas under organic crop production and increasing the export of organic products (area of agricultural land (thousand hectares); share of agricultural land under organic production in the total area of agricultural land, % ; export (billion USD).

Legal basis: Law of Ukraine "On Basic Principles and Requirements for Organic Production, Circulation and Labeling of Organic Products" No. 2496-VIII of July 10, 2018, National Economic Strategy of Ukraine for the period until 2030, draft Strategy for the Development of Agriculture and Rural Territories in Ukraine for the period until 2030

Time frame: from 2018

Responsible bodies/organizations: Ministry of Agrarian Policy

Description: The development of organic agriculture is one of the priority directions of the medium-term "green transformation" of agriculture. Organic production can play an important role in adapting to and mitigating climate change, as well as in preserving biodiversity. NES has set goals for increasing the area of land with organic status to at least 3% of the total area of agricultural land by 2030 and increasing the export of organic products to USD 1 billion by 2030.

In recent years, Ukraine has been among the top 5 exporters of organic products to the EU. In particular, in 2022, 2.73 million tons of organic agricultural products were imported into the EU, more than 8% of which was accounted for by Ukraine. Ukraine, as a candidate for the EU membership, can strengthen the EU organic market and reduce its dependence on the import of organic products from countries outside Europe. The legislation of Ukraine in the field of organic production, circulation and labeling of organic products is harmonized with Council Regulation (EC) No. 834/2007. The draft Strategy for the Development of Agriculture and Rural Areas in Ukraine for the period until 2030 provides for its further adaptation to the new Regulation of the European Parliament and the Council (EU) No. 2018/848 of May 30, 2018 on organic production and labeling of organic products, which entered into force in January 2022.

In addition, the NES envisages the development of financial and advisory support programs for producers of organic products and the involvement of a larger number of producers in conducting organic production by improving state regulation in this area.

PM_D_WAM_05 Disseminating the use of information and electronic communication technologies in crop production

Objective: increasing productivity and reducing the impact on the environment by improving the technology of the agricultural sector

Legal basis: National Economic Strategy of Ukraine for the period until 2030

Time frame: from 2018

Responsible bodies/organizations: Ministry of Agrarian Policy

Description: The development of information and electronic communication technologies makes possible their effective use in crop production for the purpose of multilateral monitoring of agricultural lands and effective planning and implementation of technologies for growing field crops. The timely implementation of appropriate measures (foliage fertilization, irrigation, application of pesticides, soil cultivation, phytosanitary monitoring, etc.) in the appropriate amount will contribute to the optimization of the technology of growing agricultural crops and will have an additional positive effect - the reduction of greenhouse gas emissions.

The national economic strategy provides for an increase in the technological level of the agricultural sector and for monitoring the quality of land resources, which includes the implementation of the following tasks by 2030:

- development of a program and tools for the introduction of technologies in the agro-industrial sector with the help of state support with an emphasis on the domestic producer;
- development of software for cooperatives (interaction between participants, standardization of processes, accounting and planning, training, use of knowledge bases);
- establishment of a network of weather stations with dense coverage and data accuracy acceptable for modeling due to the inclusion of existing private sector weather stations;
- creating development programs and attracting companies to open research centers;
- systematic monitoring of soil fertility indicators and their quality, introduction of satellite monitoring;

- ensuring the adjustment of crop cultivation technologies taking into account the results of navigation with the global positioning system and agricultural machinery.

Policies and measures to reduce GHG emissions in the LULUCF sector

PM_D_WAM_06 Demining and reforestation after hostilities

Objective: establishment of effective forest management in the territories that were negatively affected by the armed aggression of the Russian Federation against Ukraine for their demining and restoration (thousands of hectares of demined and restored forests)

Legal basis: Forest Code of Ukraine, Decree of the Cabinet of Ministers of Ukraine of December 29, 2021 No. 1777-r "On the Approval of the State Forest Management Strategy of Ukraine until 2035" (Official Gazette of Ukraine, 2022, No. 4, Article 265)

Time frames: from 2024

Responsible bodies/organizations: Ministry of Environment, State Forestry Agency, State Agency of Ukraine for Exclusion Zone Management, State Emergency Service, Ministry of Defense, regional and Kyiv city state (military) administrations

Description: According to the Forest Management Strategy of Ukraine until 2035, approved by the Decree of the Cabinet of Ministers of Ukraine of December 29, 2021 No. 1777-r (Official Gazette of Ukraine, 2022, No. 4, Article 265), as a result of the armed aggression of the Russian Federation against Ukraine from February 20, 2014, hostilities continue on an area of about 2,731 thousand hectares of forests. Heavy military equipment is being moved in the forests, military operations have been or are being conducted, which can lead to both contamination with explosive objects and disruption of terrestrial ecosystems, soils, water bodies and water management systems. According to the estimates of the Ministry of Environment, it is necessary to demine at least half a million hectares of forests in the territories under the control of Ukraine and another 0.8 million hectares in the temporarily occupied territory.

The strategy of forest management of Ukraine until 2035 provides for the establishment of effective management of forests in the exclusion zone and in the territories that have been negatively affected by the armed aggression of the Russian Federation against Ukraine.

The operational plan for the implementation of the Strategy in 2024 provides for the approval of action plans (projects) aimed at the rehabilitation of forests and the restoration of forest natural complexes damaged as a result of hostilities, as well as the survey of forests contaminated by explosive objects in the de-occupied territories. And after the end of hostilities, it is planned to carry out work on the detection, extraction and disposal of explosive objects (demining, in particular humanitarian) in forest areas in the de-occupied territories.

PM_D_WAM_07 Nationwide targeted program of land use and protection

Objective: the implementation of the state policy of Ukraine to ensure the sustainable development of land use, ensuring ecologically safe conditions for the population to live and conduct economic activities, the protection of land from depletion, degradation and pollution, the reproduction and increase of soil fertility, the preservation of the functions of the soil cover, the preservation of landscape and biological diversity in the conditions of the market environment and taking into account global climate change.

Legal basis: Law of Ukraine "On Land Protection" No. 962-IV of June 19, 2003, Order of the Cabinet of Ministers of Ukraine No. 70-r of January 19, 2022 "On Approval of the Concept of the Nationwide Target Program for Land Use and Protection" (Official Gazette of Ukraine, 2022, No. 11, Article 588)

Time frame: approval of the program is expected approximately six months after the end of martial law

Responsible bodies/organizations: Ministry of Agrarian Policy

Description: The concept of the State-wide targeted program of land use and protection (hereinafter - the Program) approved by the Order of the Cabinet of Ministers of Ukraine of January 19, 2022 No. 70-r (Official Gazette of Ukraine, 2022, No. 11, Article 588) defines that the main result of the implementation of the Program is the preservation and reproduction of the productive potential of land

as the main means of production in agriculture and forestry in the conditions of global climate change, the land market and decentralization of power.

At the first stage of the implementation of the Program, it is envisaged to improve the legislative, scientific, informational, organizational support for the rational use of land resources and their protection at the national level, the creation of a normative-legal and normative-technical base, including norms and rules in the field of land management, for the implementation of the Program as a whole, as well as the development of land management schemes and technical and economic justifications for the use and protection of lands of administrative-territorial units, territories of territorial communities; comprehensive plans for the spatial development of the territory of territorial communities; development of criteria for monitoring; principles of monitoring based on automated information and analytical systems and remote sensing of the Earth. It is also assumed the implementation of urgent and effective measures regarding the use and protection of land, which will ensure the achievement of a positive economic, social and ecological effect, and the cessation of soil degradation.

At the second stage, it is planned to implement measures provided for by land management schemes and technical and economic justifications for the use and protection of lands of administrative-territorial units, territories of territorial communities; comprehensive plans for the spatial development of the territory of territorial communities; development and implementation of algorithms and technologies for the automated collection, processing, supply and publication of land-spatial information within the framework of the geo-informational automated platform of the national level.

It is assumed that the implementation of the measures defined by the Program will ensure the achievement of such results as:

- decrease area of land used for agricultural purposes (by 5 percent) and plowed territory (by 10 percent);
- optimization of the structure of the agricultural landscape, land plots;
- increasing the productivity of agricultural land (by 40-50 percent) through the rational use of organic, organo-mineral and mineral fertilizers and chemical meliorants on acidic and saline soils;
- increasing the area of land with natural landscapes to a level sufficient to preserve landscape and biological diversity (up to 10.5 percent of the total area of the country);
- establishment of a unified and complete system of forest improvement measures, preservation of protective forest stands, taking measures to restore them;
- conservation of degraded, unproductive and technologically polluted lands;
- conservation of natural wetlands;
- implementation of ecological and socio-economic rehabilitation of lands contaminated with radionuclides;
- reducing the threat to land resources from degradation processes and promoting the achievement of a neutral level of land degradation;
- establishment and regulation of water protection zones and coastal protective strips of water bodies, introduction of a special regime of land use in the areas where rivers flow;
- preservation of natural landscapes on the lands of industry, transport, communications, defense, etc.;
- development of ecological-economic, soil-erosion and other types of land zoning of Ukraine, which generalize the idea of the land fund of the country and are the basis of the information base and justification of the system of environmental protection measures;
- improvement of natural and agricultural zoning of Ukrainian lands taking into account global climate change;
- introduction of a complete system of normative legal acts and normative technical documents in the field of land use, accounting and protection;

- substantiating directions of fundamental and applied scientific research in the field of land use and protection;
- introduction of the land use regime in protective and security zones;
- introduction of periodic soil survey; improvement of soil monitoring on lands of all categories and forms of ownership;
- improvement of state administration in the field of land use and protection;
- development of a model of sustainable land use for natural and agricultural regions of Ukraine and ensuring the sustainable development of land use as a whole;
- development of scientific and methodical principles of land monitoring based on remote sensing of the Earth, geo-information technologies;
- provision of information exchange by unique identifiers of objects of information systems.

The development and submission to the Verkhovna Rada of Ukraine of the draft Law of Ukraine on the approval of the Nationwide target program of land use and protection is provided for by the Order of the Cabinet of Ministers of Ukraine of January 19, 2022 No. 70-r "On the approval of the Concept of the State-wide target program of land use and protection" and was planned for 2022. However, due to the full-scale invasion of the Russian Federation, the development of the program was postponed due to the impossibility of assessing the condition of the lands in the temporarily occupied territories.

Policies and measures to reduce GHG emissions in the waste sector

PM_D_WAM_08 Disseminating the practice of household waste components reuse

Objective: increasing the amount of household waste prepared for reuse and recycling (thousand tons/year)

Legal basis: Law of Ukraine "On Waste Management" of June 20, 2022 No. 2320-IX¹⁷⁷, draft National Waste Management Plan of Ukraine until 2033¹⁷⁸

Time frames: 2024-2033

Responsible bodies/organizations: Ministry of Environment, Ministry of Infrastructure, local self-government bodies

Description: The Law of Ukraine "On Waste Management" (Article 37) establishes the following targets for preparation for reuse and recycling of household waste:

¹⁷⁷ <https://zakon.rada.gov.ua/laws/show/2320-20#Text>

¹⁷⁸

<https://mepr.gov.ua/wp-content/uploads/2023/12/proyekt-Natsionalnyj-plan-upravlinnya-vidhodamy-23.11-002.docx>

- by 2025 - at least 10% of their mass;
- by 2030 - at least 20% of their mass;
- by 2035 - at least 25% of their mass;
- by 2040 - at least 35% of their mass.

At the same time, the draft Law of Ukraine "On Packaging and Packaging Waste" (reg. No. 10066 of September 18, 2023), submitted by the Cabinet of Ministers of Ukraine, provides, among other things, the postponement of the introduction of the indicator of preparation for reuse and recycling of household waste after its termination or cancellation of martial law.

According to the action plan of the draft National Waste Management Plan (NWMP) of Ukraine, in 2024, the Ministry of Infrastructure plans to develop a methodology for calculating target indicators for preparation for reuse and recycling of household waste, as well as the procedure and form of reporting on their implementation. The Ministry of Environment is responsible for the development of the draft act of the Cabinet of Ministers of Ukraine "On approval of Recommendations on reuse and charitable donation of products" in 2026.

The action plan of the draft NWMP also plans to create an appropriate infrastructure for the collection, storage, preparation for reuse, recycling, and other recovery of packaging waste during 2024–2030. Further, during 2024–2033, it is planned to create centers/mobile points for the separate collection and preparation for reuse of household waste for which the extended producer responsibility system has not been established.

In addition, the action plan of the draft NWMP envisions, during 2024–2028, the introduction of tools to stimulate and encourage manufacturers to ensure the availability of spare parts, operating instructions, technical information or other tools, equipment or software that allow for repairs and ensure the reuse of products without reducing the level of its quality and safety of functioning when products are sold on the territory of Ukraine.

PM_D_WAM_09 Disseminating the practice of household waste recycling

Objective: increase in the volume of household waste for which recycling operations have been carried out (thousand tons/year).

Legal basis: Law of Ukraine "On Waste Management" of June 20, 2022 No. 2320-IX, draft of the National Waste Management Plan of Ukraine until 2033

Time frames: 2024-2033

Responsible bodies/organizations: Ministry of Environment, Ministry of Infrastructure, local self-government bodies

Description: According to the Law of Ukraine "On Waste Management", *"recycling is a recovery operation, as a result of which waste is processed into products, materials or substances for their use for a primary or other purpose. This operation includes the processing of organic material, but does not include the production of energy or the conversion of waste into materials that can be used as fuel or as backfill materials."*

Today, there are 94 waste recycling enterprises in Ukraine: 17 waste paper recycling enterprises, 39 polymer recycling enterprises, 19 plastic bottle recycling enterprises, and 19 broken glass recycling enterprises. However, their capacities are used by 50–70% due to the shortage of secondary raw materials on the domestic market, which is covered by imports. The secondary raw materials obtained are of rather low quality due to irresponsible waste management, primarily packaging. Legislation should establish mechanisms for financing the recycling sector, which will facilitate the establishment of sorting and recovery facilities that will provide the market with a sufficient amount of quality raw materials.

The Verkhovna Rada has registered a draft governmental law "On packaging and packaging waste" (reg. No. 10066 of 18.09.2023), which provides that the following year after the implementation of this

law, the general rate of packaging recycling will be 30%, with the determination of the percentage of recycling separately for each type of waste (paper/cardboard, glass, plastics, ferrous metals, aluminum, wood) with subsequent increases each year.

According to the draft NWMP, in 2024, the Ministry of Infrastructure plans to develop a methodology for calculating target indicators for preparation for reuse and recycling of household waste, as well as the procedure and form of reporting on their implementation.

In addition, the action plan of the draft NWMP plans to create an infrastructure for the collection, storage, preparation for reuse, recycling, and other recovery of packaging waste during 2024–2033.

PM_D_WAM_10 Disseminating the practice of household waste organic components composting

Objective: increasing the amount of household waste that has undergone biological treatment using anaerobic fermentation and composting methods (thousand tons/year)

Legal basis: Law of Ukraine "On Waste Management" of June 20, 2022 No. 2320-IX, draft of the National Waste Management Plan of Ukraine until 2033

Time frames: 2024-2033

Responsible bodies/organizations: local self-government bodies, Ministry of Infrastructure, Ministry of Environment

Description: The average annual volume of biowaste makes up about half of the total volume of generated household waste in Ukraine, which, in turn, differs significantly by region and type of settlement. Biodegradable waste is currently not collected separately.

The draft NWMP proposes the construction of facilities for composting waste in territorial communities (or their associations as a result of the signing of cooperation agreements) with a population of 100,000 or more inhabitants with an average optimal capacity of 5,000 tons of finished compost per year as part of complexes of mechanical and biological processing or regional centers for separate collection of waste. Such an approach will significantly shorten the process of their design and construction, as the need for land allocation procedures and the development and approval of project documentation will disappear, as well as logistical and operating costs will be significantly reduced. There is a positive experience of such a project in the city of Lviv. The implementation of composting and the choice of technology are determined by regional and local waste management plans. In territorial communities with a population of up to 100,000 people, it is advisable to carry out composting at specialized composting sites, and in small territorial communities - composting at waste disposal sites in curbs or "sleeves". Bio-waste composting can be carried out in rural areas and suburban areas of cities in homesteads, summer cottages and garden plots. Composting operations can be used by waste reception/collection centers to process separately collected waste from green spaces (waste from households, parks, gardens, other landscaping objects). Composting of the above-mentioned waste can be done outdoors.

The action plan of the draft NWMP envisions during 2024–2033 the construction of composting facilities for household waste and waste from green plantings from landscaping facilities, as well as promoting the introduction of waste composting in homesteads, summer cottages, and garden plots. In addition, it is envisaged to install sorting lines at landfills for non-hazardous waste, to separate biodegradable waste, and to create composting sites in order to reduce the landfilling of biodegradable waste: by 2028 - at landfills that accept 100 tons of waste per day; by 2030 - at landfills that receive more than 100 tons of waste per day.

PM_D_WAM_11 Disseminating the practice of thermal treatment of household waste (with obtaining useful energy)

Objective: to increase the volume of household waste, in respect of which recovery operations have been carried out (incineration with obtaining energy), as well as waste, in respect of which operations

of treatment by other thermal methods (pyrolysis, gasification, plasma process) have been carried out (thousand tons/year).

Legal basis: Law of Ukraine "On Waste Management" of June 20, 2022 No. 2320-IX, draft of the National Waste Management Plan of Ukraine until 2033

Time frames: 2024-2033

Responsible bodies/organizations: Ministry of Environment, Ministry of Infrastructure, local self-government bodies

Description: According to the Law of Ukraine "On Waste Management", *thermal treatment of waste is a technological process of thermal treatment of waste that meets the rules of technical operation of the relevant installation.* By Order of the Cabinet of Ministers of Ukraine No. 229 of March 1, 2024, the technical requirements for the operation of waste incineration plants and waste co-incineration plants were approved (Official Gazette of Ukraine, 2024 p., No. 25, Article 1613), which will enter into force on September 5 2024.

There is only one waste incineration plant operating in Ukraine - with a capacity of about 250,000 tons per year in the city of Kyiv, which produces useful thermal energy for the communal and household needs of the nearby housing stock, and provides processing of about 2% of the total volume of waste generated in the country. Currently, household waste is not used as an alternative type of fuel in industry.

The action plan of the draft NWMP envisages the development and approval of recommendations for the use of fuel derived from waste (RDF) until 2026. In addition, during 2025–2033, it is planned to build household waste treatment facilities, including heat treatment, within the budget funding provided for local executive bodies and local self-government bodies, at the expense of the funds of the environmental protection fund, the involvement of “green” bonds, funds of international technical assistance and other sources not prohibited by law.

PM_D_WAM_12 Increasing the amount of disposal (recovery and flaring) of biogas at landfills

Objective: increasing the share of disposal (recovery and flaring) of biogas at landfills (% of the total volume of methane generated).

Legal basis: Law of Ukraine "On Waste Management" of June 20, 2022 No. 2320-IX, draft of the National Waste Management Plan of Ukraine until 2033

Time frames: 2024-2033

Responsible bodies/organizations: Ministry of Environment, Ministry of Infrastructure, local self-government bodies

Description: The landfill methane flaring technology became widespread in Ukraine in 2005-2010 as part of the financial incentives of the Kyoto Protocol. Over the next 10 years, this technology was completely replaced by electrical energy production facilities, the financial incentive for which was the "green tariff". Nevertheless, flaring is a cheaper technology, so its use is appropriate under conditions of low biogas throughput and a significant increase in operating costs associated with emissions of pollutants and especially the greenhouse gas methane.

According to the draft NWMP, the closure and reclamation of old landfills and those that do not meet the requirements will be carried out in parallel with the construction of new regional landfills. The Law of Ukraine "On Waste Management" from 2030 prohibits the operation of landfills that are not equipped with biogas and leachate extraction and disposal systems (Clause 5 of the Final and Transitional Provisions), systems for monitoring emissions into the atmosphere and monitoring soil and groundwater pollution, therefore by this time, measures in regional and local plans for closing, reclamation and construction of landfills should be foreseen and implemented. If it is not possible to implement these measures by 2030, the ban does not apply if the plan to bring the waste disposal site into compliance with legal requirements is implemented.

Thus, the action plan of the the draft NWMP foresees the construction of regional landfills for non-hazardous waste during 2024–2033 with the possibility of creating separate maps of landfills for the removal of inert or hazardous waste or other waste treatment facilities, and during 2028–2033 the phase-out of the operation of household waste disposal sites (landfills) that do not meet the requirements of the law is planned (after the construction of new landfills), in particular, those landfills that, as of January 1, 2030, will not be equipped with biogas extraction and disposal systems in accordance with paragraph 5 of the Final Regulations and transitional provisions of the Law of Ukraine "On Waste Management".

ii. Where relevant, regional cooperation in this area

The strategy for the formation and implementation of state policy in the field of climate change for the period until 2035, approved by the order of the Cabinet of Ministers of Ukraine of May 30, 2024 No. 483-r (Government Courier, 2024 p. No. 114), provides for the development and approval of the procedure for review, approval and implementation of projects aimed at reducing the volume of anthropogenic emissions or increasing the absorption of greenhouse gasses in accordance with Article 6 of the Paris Agreement. Accordingly, this will provide the necessary conditions for the conclusion of agreements on bilateral cooperation by initiating voluntary cooperation under Article 6 of the Paris Agreement.

iii. Without prejudice to the applicability of State aid rules, financing measures in this area at national level, where applicable

Within the framework of the budget program of the KPKVK 2701530 "State support for measures aimed at reducing emissions (increasing absorption) of greenhouse gasses, including insulation of the premises of social welfare institutions, developing international cooperation on climate change", measures for thermal modernization of social sector buildings are funded.

The Budget Code of Ukraine provides for the establishment of the State Fund for Decarbonization and Energy-Efficient Transformation from January 1, 2024, and revenues from the tax on CO₂ emissions are determined as one of the its funding sources (see in detail section 3.2, PM_EE_WEM_02).

iv. Development of carbon pricing instruments and when relevant, functioning of the carbon market or any carbon pricing instruments

See PM_D_WAM_02 National GHG Emissions Trading System.

3.1.2. Renewable energy

i. Policies and measures to achieve the national contribution to the 2030 Energy Community target for renewable energy and trajectories as referred to in point (a)(2) Article 4, and, where applicable or available, the elements referred to in point 2.1.2 of this Annex, including sector- and technology-specific measures

PM_D_WEM_02 "Green" tariff for renewable electricity producers

Objective: stimulating the development of the RES sector (share in the total final energy consumption)

Legal basis: Law of Ukraine "On Alternative Energy Sources", Law of Ukraine "On the Electricity Market", Law of Ukraine "On Amendments to Certain Laws of Ukraine Regarding the Establishment of a "Green" Tariff", Law of Ukraine "On Amendments to Certain Laws of Ukraine Regarding improving the conditions for supporting the production of electricity from alternative energy sources", Law of Ukraine "On Amendments to Certain Laws of Ukraine Regarding the Restoration and "Green" Transformation of the Energy System of Ukraine", Resolution of the NEURC of April 26, 2019 No. 641 "On Approval of Regulatory Legal Acts regulating the activities of the guaranteed buyer and the

purchase of electricity under the "green" tariff, the purchase of services under the mechanism of the market premium"

Time frames: 2009-2029

Responsible bodies/organizations: Ministry of Energy, NEURC

Description: The main tool for stimulating the development of the RES sector was the "green" tariff, which was introduced in 2008 by the Law of Ukraine "On Amendments to Certain Laws of Ukraine Regarding the Establishment of a "Green" Tariff"¹⁷⁹.

In accordance with the Law of Ukraine "On Alternative Energy Sources" (hereinafter referred to as the Law), the "green" tariff is a special tariff for the purchase of electricity produced at electric power facilities, in particular at the commissioned phase of the construction of power stations (start-up complexes), from alternative energy sources (and with the use of hydropower only by micro-, mini- and small hydropower plants).

The "green" tariff for economic entities that produce electricity from wind energy is set at the level of the retail tariff for consumers of the second voltage class as of January 2009, multiplied by the coefficient of the "green" tariff. For business entities, private households and consumers, including energy cooperatives, which produce electricity using alternative energy sources, the "green" tariff is set until January 1, 2030. The fixed minimum size of the "green" tariff for business entities, private households and consumers, including energy cooperatives, is established by converting the "green" tariff calculated in accordance with the rules of this Law into euros, as of January 1, 2009, at the official exchange rate of the National Bank of Ukraine on the specified date. Also, the "green" tariff is calculated in accordance with the requirements of the Law and is converted quarterly into the national currency at the average official exchange rate of the National Bank of Ukraine.

Fulfillment of state guarantees regarding the purchase of all electricity produced at power facilities that use alternative energy sources (in case of hydropower - produced only by micro-, mini- and small hydroelectric power plants), at the established "green" tariff, is carried out by the guaranteed buyer and universal services providers within the framework of the performance of special duties to ensure an increase in the share of electricity production from alternative energy sources. In turn, the guaranteed buyer and universal service providers receive compensation from the transmission system operator Ukrenergo for the service of ensuring an increase in the share of electricity production from alternative energy sources. The cost of supporting producers of renewable energy is included in the NPC "Ukrenergo" tariff for the transmission of electricity. However, due to the fact that the electricity transmission tariff is insufficient to cover the full cost of electricity production from renewable energy sources under the "green" tariff, as well as due to the consequences of the full-scale aggression of the Russian Federation against Ukraine, settlements of the SE "Guaranteed Buyer" with producers under the "green" tariff were not fully undertaken.

Taking into account the rapid commissioning of renewable energy facilities, the level of "green" tariffs, the total capacity of projects for which previous contracts have been concluded, as well as the imbalance that has arisen in the system and on the electricity market, the Government has initiated negotiations with investors in renewable energy through the Energy Community Secretariat about voluntary restructuring of "green" tariffs. On June 10, 2020, the key parties signed a Memorandum of Understanding on the settlement of problematic issues in the field of renewable energy in Ukraine. The provisions of the Memorandum were reflected in the Law of Ukraine "On Amendments to Certain Laws of Ukraine Regarding the Improvement of Conditions for Supporting the Production of Electricity from Alternative Energy Sources"¹⁸⁰, which provides for a reduction in the rates of benefits for wind and solar power plants by 7.5% and 15%, respectively, introduction of responsibility for the imbalance of electricity, repayment of debts, etc. Given the difficult situation in the industry, Ukraine did not go for a unilateral reduction of "green" tariffs, but reached a settlement on this issue through long negotiations with investors, search for compromises and conclusion of the Memorandum, which became the basis of the relevant law of Ukraine.

¹⁷⁹ <https://zakon.rada.gov.ua/laws/show/601-17#Text>

On June 30, 2023, the Verkhovna Rada of Ukraine adopted Law of Ukraine No. 3220-IX "On Amendments to Certain Laws of Ukraine Regarding the Restoration and "Green" Transformation of the Energy System of Ukraine"¹⁸¹, which from January 1, 2024 narrows the application of the "green" tariff only to private households, provided that there are buildings and other capital structures in their ownership and that the electricity is consumed by private household. State support for renewable electricity producers and private households in the form of a "green" tariff will be available until December 31, 2029.

In general, the "green" tariff contributed to a rapid increase in the production of electricity from RES, from 51.8 million kWh in 2009¹⁸² to 11.4 billion kWh in 2021¹⁸³. At the beginning of 2022, the installed capacity of RES facilities that received a "green" tariff, excluding facilities located in temporarily occupied territories, amounted to 9,656 MW (10.1 GW, taking into account facilities occupied until February 24 2022). In addition, during 2022, about 312 MW of new RES capacities were built, of which:

- 220.1 MW – solar power plants (22 facilities up to 1 MW and 206 MW household SPP);
- 81.6 MW – wind power plants (4 facilities);
- 2.5 MW – biothermal power plant (1 facility);
- 6.3 MW – biogas plants (4 facilities);
- 1.17 MW – small hydroelectric power stations (2 facilities); (including about 200 MW of SPP of households).

During 2023, about 350 MW of new RES capacities were introduced:

- 145 MW of wind power plants in Mykolaiv, Odesa and Lviv regions;
- about 170 MW of solar power plants at the "green" tariff (industrial and household, data to be clarified);
- 40 MW biothermal power plant;
- 1 MW – biogas plants;
- 0.05 MW small hydropower plants.

¹⁸⁰ <https://zakon.rada.gov.ua/laws/show/810-20#Text>

¹⁸¹ <https://zakon.rada.gov.ua/laws/show/3220-20#Text>

¹⁸² Annual report of the NEURC for 2014, https://www.nerc.gov.ua/data/filearch/Catalog3/Richnyi_zvit_2014.pdf

¹⁸³ https://www.nerc.gov.ua/storage/app/sites/1/Docs/Byuleten_do_richnogo_zvitu/byuleten_do_richnogo_zvitu_NEURC-2021.pdf

PM_D_WEM_03 Incentive tariff for thermal energy producers from RES

Objective: stimulating the generation of thermal energy from alternative sources (the share of the use of alternative energy sources in the production of thermal energy by facilities in the field of heat supply)

Legal basis: Law of Ukraine "On Heat Supply", Law of Ukraine "On Amendments to the Law of Ukraine "On Heat Supply" Regarding Stimulating the Production of Thermal Energy from Alternative Energy Sources"

Time frame: from 2017

Responsible bodies/organizations: Ministry of Infrastructure, Ministry of Energy, State Energy Efficiency Agency, NEURC, local self-government bodies

Description: In order to stimulate the production of thermal energy from RES, the Verkhovna Rada of Ukraine adopted the Law of Ukraine "On Amendments to the Law of Ukraine "On Heat Supply" on Stimulating the Production of Thermal Energy from Alternative Energy Sources" of March 21, 2017 No. 1959-VIII¹⁸⁴. The law determines the approach for setting the tariff for thermal energy produced at installations using alternative energy sources for the needs of institutions and organizations financed from the state or local budget, as well as for the needs of households, particularly, the calculation and establishment of tariffs is envisioned at the level of 90% of the current tariff for thermal energy produced using natural gas (and in the absence of it - at the level of the weighted average tariff for thermal energy from gas in the region).

In order to resolve problematic issues of heat supply enterprises, including those that produce thermal energy using alternative energy sources, the Verkhovna Rada of Ukraine has registered a government draft Law of Ukraine "On Amendments to Certain Laws of Ukraine Regarding the Settlement of Accounts Payable of Heat and Water Supply Enterprises" (reg. No. 11273 of 05/20/2024)¹⁸⁵.

The above-mentioned draft Law envisages amendments to Art. 20 of the Law of Ukraine "On Heat Supply" to provide an opportunity for business entities that produce thermal energy using alternative energy sources to establish tariffs for thermal energy, its production, in addition to the calculation mechanism based on the 90% principle, also in accordance with the procedures (methods) of setting tariffs for thermal energy, its production, transportation and supply, approved by the Cabinet of Ministers of Ukraine or NEURC, which in turn will ensure coverage of all economically justified costs incurred by enterprises in the course of heat production. The method of calculating tariffs will be determined directly by the economic entity that produces thermal energy using alternative energy sources.

PM_D_WEM_04 Tax benefits for importing RES equipment

Objective: Stimulation the RES development by reducing the cost of imported equipment operating on RES (share in the structure of total final energy consumption)

Legal basis: Tax Code of Ukraine, Customs Code of Ukraine, Resolution of the Cabinet of Ministers of Ukraine of March 30, 2016 No. 293 "On the import of energy-saving materials, equipment and components into the customs territory of Ukraine under Japanese technologies demonstration projects" (Official Gazette of Ukraine, 2016 p., No. 31, Article 1242)

Time frame: since 2010

Responsible bodies/organizations: Ministry of Finance, State Tax Service, State Customs Service

¹⁸⁴ <https://zakon.rada.gov.ua/laws/show/1959-19#Text>

¹⁸⁵ <https://itd.rada.gov.ua/billInfo/Bills/Card/44267>

Description: The Tax Code of Ukraine provides for a number of tax benefits for businesses operating in the RES sector. In particular, it provides for exemption from payment of value-added tax on import operations into the customs territory of Ukraine:

- equipment that works on renewable energy sources, energy-saving equipment and materials, means of measurement, control and management of consumption of fuel and energy resources, equipment and materials for the production of alternative types of fuel or for the production of energy from renewable energy sources;
- materials, equipment, components used for production;
- equipment that works on renewable energy sources;
- materials, raw materials, equipment and components that will be used in the production of alternative types of fuel or the production of energy from renewable energy sources;
- energy-saving equipment and materials, products, the operation of which ensures saving and rational use of fuel and energy resources.

In addition, Article 282 of the Customs Code of Ukraine stipulates that the above-mentioned equipment and devices are exempt from customs duties when imported into the customs territory of Ukraine or exported outside its borders. However, the duty exemption applies only if these goods are used by the taxpayer for their own production and if identical goods with similar quality indicators are not produced in Ukraine.

Moreover, the application of the above norms is possible only on the condition that such goods are included in the List of energy-saving materials, equipment and components under the Japanese technologies demonstration projects, which are exempt from import duties and VAT, approved by the resolution of the Cabinet of Ministers of Ukraine of March 30, 2016 No. 293 (Official Gazette of Ukraine, 2016 p., No. 31, Article 1242)¹⁸⁶.

PM_D_WEM_05 Market premium mechanism for renewable electricity producers (feed-in premium)

Objective: ensuring the development of renewable electricity on a competitive basis, integration of "green" generation into the power system and the electricity market.

Legal basis: Law of Ukraine "On the Electricity Market", Law of Ukraine of June 30, 2023 No. 3220-XX "On Amendments to Certain Laws of Ukraine Regarding the Restoration and "Green" Transformation of the Energy System of Ukraine", Resolution of the NEURC of April 26, 2019 No. 641 "On the approval of legal acts regulating the activities of the guaranteed buyer and the purchase of electricity at the "green" tariff, the purchase of services using the market premium mechanism."

Time frame: from 2024

Responsible bodies/organizations: Ministry of Energy, NEURC

Description: On June 30, 2023, the Verkhovna Rada of Ukraine adopted Law of Ukraine No. 3220-IX "On Amendments to Certain Laws of Ukraine Regarding the Restoration and "Green" Transformation of the Energy System of Ukraine", which introduced a number of new market instruments to support producers of electricity from RES, in particular, the mechanism of market premium (Feed-in-Premium) for producers at the "green" tariff and contracts for the difference for the winners of the auctions.

¹⁸⁶ <https://zakon.rada.gov.ua/laws/show/293-2016-%D0%BF#n16>

In order to implement the provisions of the Law of Ukraine of June 30, 2023 No. 3220-XX "On Amendments to Certain Laws of Ukraine Regarding the Restoration and "Green" Transformation of the Energy System of Ukraine", the Resolution of the National Energy Regulatory Commission of Ukraine of January 24, 2024 No. 178 "On Amendments to some resolutions of the National Commission, which carries out state regulation in the areas of energy and communal services", which fully implemented the market premium mechanism at the level of subordinate regulatory legal acts.

For the implementation of the norms of the Law of Ukraine of June 30, 2023 No. 3220-XX "On Amendments to Certain Laws of Ukraine Regarding the Restoration and "Green" Transformation of the Energy System of Ukraine", Resolution of the NEURC of January 24, 2024 No. 178 "On Amendments to some resolutions of the National Commission, which carries out state regulation in the areas of energy and communal services" introduced the following:

- amendments were made to the Procedure for the purchase by a guaranteed buyer of electricity produced from alternative energy sources, in particular regarding the determination of the cost of the service under the market premium mechanism and the procedure for concluding a service contract under the market premium mechanism;
- the Standard contract for the provision of services to support the production of electricity from alternative sources under the market premium mechanism was approved;
- the issue of entry-exit of the electricity facility from the balancing group of the guaranteed buyer has been settled. That is, one installation of the power industry can be in the balancing group, and the other can carry out activities in market segments and receive the difference between "green" tariff and market (calculated) price;
- When a guaranteed buyer leaves the balancing group, the "green" tariff is not canceled, the licensee or individual object can return to the balancing group and continue to sell electricity at the "green" tariff.

The market premium mechanism is a system of stimulating the production of electricity from alternative energy sources, according to which the guaranteed buyer pays economic entities that have a "green" tariff and economic entities that have acquired the right to support as a result of the auction, the difference between the "green" tariff or auction price, taking into account the surcharge to it and the estimated price, determined in accordance with the procedure established by the Law of Ukraine "On the Electricity Market". Financing of the market premium mechanism will take place in accordance with the procedure defined by the legislation and will not involve attracting funds from the state and local budgets.

The market premium mechanism creates the conditions for RES electricity producers to become full-fledged market participants and independently sell the generated electricity, reducing their imbalances and optimizing revenues.

PM_D_WEM_06 Direct electricity purchase and sale contracts between producers and final energy consumers (corporate PPAs)

Objective: Stimulating the development of the RES sector on a market basis.

Legal basis: Law of Ukraine "On Alternative Energy Sources", Law of Ukraine "On the Electricity Market", Law of Ukraine of June 30, 2023 No. 3220-IX "On Amendments to Certain Laws of Ukraine Regarding the Restoration and "Green" Transformation of Energy system of Ukraine".

Time frame: from 2024

Responsible bodies/organizations: Ministry of Energy, NEURC

Description: The Law of Ukraine of June 30, 2023 No. 3220-IX "On Amendments to Certain Laws of Ukraine Regarding the Restoration and "Green" Transformation of the Energy System of Ukraine" removed a number of regulatory obstacles for the conclusion of direct electricity purchase and sale contracts between producers and end energy consumers (corporate PPAs), according to which the buyer of electricity is a private consumer, and not the state in the form of a guaranteed buyer. In particular, the obligation for RES producers to sell electricity under bilateral contracts at electronic auctions was

removed, but the right to continue using this tool on a voluntary basis remained. The Law of Ukraine also expanded the list of counterparties for concluding a contract for the provision of services to ensure the stability of the price of electricity produced from alternative energy sources to the electricity supplier and trader (in addition to the consumer). In addition, the right of NEURC to set the maximum term of validity of bilateral contracts does not now extend to contracts concluded by producers of electricity from RES. These changes have created opportunities for businesses that produce electricity from RES or plan to become such a producer to look for partners for long-term bilateral contracts for the purchase and sale of electricity at the project development stage.

It is expected that the legislative changes introduced by the Law of Ukraine of June 30, 2023 No. 3220-XX "On Amendments to Certain Laws of Ukraine Regarding the Restoration and "Green" Transformation of the Energy System of Ukraine" will stimulate the development of the segment of direct contracts for the purchase and sale of electricity between the producer of electricity from alternative energy sources and consumers (Corporate PPA's) both physical and virtual.

PM_D_WEM_07 "GreenDIM" Energy Efficiency Fund Program

Objective: to stimulate and support initiatives for the implementation of energy efficiency measures, the implementation of which ensures a reduction in the consumption of energy resources, including measures aimed at increasing the share of energy produced from renewable energy sources.

Legal basis: Law of Ukraine "On the Energy Efficiency Fund".

Time frame: from 2024

Responsible bodies/organizations: Energy Efficiency Fund, Ministry of Infrastructure

Description: On May 7, 2024, the Supervisory Board of the Energy Efficiency Fund approved¹⁸⁷ the new GreenDIM Program¹⁸⁸, which is aimed at stimulating the use of alternative energy sources by providing grants for partial reimbursement of the cost of equipment and materials during the implementation of measures to increase the share of electricity produced from renewable sources energy in the residential sector.

Participants of the Program can become:

- Association of co-owners of multi-apartment buildings;
- Housing and building cooperatives.

According to the Program, the Energy Efficiency Fund will partially reimburse the cost of:

1. Equipment and materials:
 - heat pumps — heat energy source — soil, water or air (for heating and hot water supply);
 - solar power plants (SPP).
2. Certification of the energy efficiency of the house before applying for a grant and after the implementation of the project.

Under the terms of the Program, the Fund will provide funding to participants in the form of a grant on a free and non-refundable basis. The amount of the grant is 70% of the cost of the equipment, audit and certification of the energy efficiency of the building. Program participants can receive UAH 1 million for the installation of SPPs, and UAH 2 million for the installation of heat pumps. Grant on

¹⁸⁷ <https://eefund.org.ua/novyny/naglyadova-rada-fondu-energoefektyvnosti-zatverdyla-novu-programu-grindim/>

¹⁸⁸ https://eefund.org.ua/documents/programa_grindim-redakciya-vid-04-05-2024/

reimbursement of expenses for energy efficiency certification services of the building — up to UAH 15,000. At the same time, if a SPP and a heat pump are installed at the same time, the grant can be paid in the amount of no more than UAH 3 million.

In addition, the Energy Efficiency Fund ensures the implementation of two other programs aimed at stimulating the improvement of the energy efficiency of buildings, which are described in detail in section 3.2 (see PM_EE_WEM_01).

PM_D_WAM_13 System of auctions for distribution of support quota for RES

Objective: to establish a competitive basis for providing support to renewable energy projects and achieve a balance of interests of society and consumers of electricity and other market participants, ensuring at the same time the further development of renewable energy and reducing the burden on the electricity price.

Legal basis: Law of Ukraine "On Alternative Energy Sources", Law of Ukraine "On the Electricity Market", Law of Ukraine of April 25, 2019 No. 2712-VIII "On Amendments to Certain Laws of Ukraine Regarding Ensuring Competitive Conditions for the Production of Electricity from Alternative Energy Sources", Law of Ukraine of June 30, 2023 No. 3220-IX "On Amendments to Certain Laws of Ukraine Regarding Restoration and "Green" Transformation of the Energy System of Ukraine", Resolution of the Cabinet of Ministers of Ukraine of December 29, 2019 No. 1175 "On introduction of competitive conditions for stimulating the production of electricity from alternative energy sources" (Official Gazette of Ukraine, 2020 p., No. 10, Art. 388), Resolution of the NEURC of April 26, 2019 No. 641 "On the approval of regulatory acts regulating the activity of the guaranteed buyer and the purchase of electricity at a "green" tariff, the purchase of services using the market premium mechanism", Order of the Ministry of Energy of September 14, 2020 No. 596 "On approval of the standard agreement on conducting electronic auctions on the distribution of the support quota between the auction customer and the operator of the electronic platform".

Time frame: operation until 2029

Responsible bodies/organizations: Ministry of Energy, NEURC, SE "Guaranteed Buyer", SE "Prozoro.Prodazhi", NPC "Ukrenergo"

Description: In order to increase the competition in the renewable energy market, the Law of Ukraine No. 2712-VIII¹⁸⁹ introduced an auction mechanism for large renewable energy installations in 2019. According to the Law of Ukraine, wind and solar installations with an installed capacity of more than 5 MW and 1 MW, respectively, are required to participate in auctions for the allocation of support quotas, and small producers can participate voluntarily. Small installations at household level with a capacity not exceeding 50 kW are still eligible for green tariffs until 2029.

In order to launch RES auctions, the Cabinet of Ministers of Ukraine adopted Resolution No. 1175 of December 27, 2019 "On the introduction of competitive conditions for stimulating the production of electricity from alternative energy sources" (Official Gazette of Ukraine, 2020 p., No. 10, Article 388)¹⁹⁰, which approves the procedure for conducting auctions and allocating quotas to support RES.

On June 30, 2023, the Verkhovna Rada of Ukraine adopted the Law of Ukraine No. 3220-IX "On Amendments to Certain Laws of Ukraine Regarding the Restoration and "Green" Transformation of the Energy System of Ukraine", which improved the model of conducting auctions for the distribution of quotas for supporting electricity producers from energy sources, in particular, the above-mentioned Law introduced the following changes:

- setting the term of support up to 12 years;
- introduction of a contract-for-difference model (market premium mechanism) instead of a fixed tariff;
- simplification of conditions for participation in auctions;

¹⁸⁹ <https://zakon.rada.gov.ua/laws/show/2712-19#Text>

¹⁹⁰ <https://zakon.rada.gov.ua/laws/show/1175-2019-%D0%BF#Text>

- conducting auctions for the construction of renewable energy facilities together with energy storage facilities;
- determining certain hours of the day during which support can be provided based on the results of the auction;
- granting the right to the Cabinet of Ministers of Ukraine to determine the share of the auction price, which is fixed in euros, but not less than 50%;
- determining the load profiles of renewable energy facilities for which the right to support was acquired as a result of the auction.

In accordance with Article 9³ of the Law of Ukraine "On Alternative Energy Sources", the Cabinet of Ministers of Ukraine, at the request of the Ministry of Energy, establishes the annual support quota and the schedule of auctions for the following year, as well as indicative forecast indicators of the annual support quotas for four years following the year for which the annual support quota is established. Proposals regarding the amount of annual support quotas are prepared by NPC "Ukrenergo" taking into account Ukraine's international obligations regarding the development of renewable energy, the Energy Strategy of Ukraine, the national action plan for the development of renewable energy, the Generation capacity adequacy assessment report and the plan for the development of the transmission system, the state of implementation of projects for the construction of renewable energy facilities. Proposals regarding the maximum price offered by the auction participant for the next year per each alternative energy source are prepared by the National Commission, which carries out state regulation in the areas of energy and communal services. The first quotas and indicative indicators are planned to be established by the end of 2024 for the years 2025-2029. The possibility of holding pilot auctions in 2024 is being considered.

It is expected that the auction mechanism will promote the development of RES on a competitive basis. However, as of the beginning of 2024, this tool is not yet operational. Currently, the Ministry of Energy is working on the possibility of launching auctions taking into account the challenges of martial law.

PM_D_ WAM_14 Guarantees of origin of electricity from RES

Objective: stimulating the development of renewable electricity on a competitive basis, as well as implementing the provisions of European legislation, in particular, Directive 2018/2001/EU of the European Parliament and of the Council of December 11, 2018 "On the promotion of the use of energy from renewable sources".

Legal basis: Law of Ukraine "On Alternative Energy Sources", Law of Ukraine of June 30, 2023 No. 3220-IX "On Amendments to Certain Laws of Ukraine Regarding Restoration and "Green" Transformation of the Energy System of Ukraine", Resolution of the Cabinet of Ministers of Ukraine of 27 of February 2024 No. 227 "On the introduction of guarantees of the origin of electricity produced from renewable energy sources" (Official Gazette of Ukraine, 2024 p., No. 26, Article 1653), resolution of the NEURC of December 27, 2023 No. 2624 "On Approval of the procedure for establishment and maintaining a register of electricity facilities and electrical installations of consumers (including active consumers) that use alternative energy sources for the production of electricity", DSTU EN 16325:2022 Guarantees of origin related to energy, Guarantees of origin of electricity (EN 16325:2013+A1:2015, IDT).

Time frame: from 2024

Responsible bodies/organizations: NEURC, Ministry of Energy

Description: At the end of June 2023, the Verkhovna Rada of Ukraine adopted the Law of Ukraine of June 30, 2023 No. 3220-IX "On Amendments to Certain Laws of Ukraine Regarding the Restoration and "Green" Transformation of the Energy System of Ukraine", which introduced a mechanism for issuing, using and terminating guarantees of origin of electricity produced from RES. The law of Ukraine specifies that the guarantee of origin of electricity produced from renewable energy sources is an electronic document created on the basis of information from the register of guarantees of origin of electricity produced from renewable energy sources, which confirms that a certain amount of electricity is produced from renewable energy sources, confirms its ecological value and certifies the rights

associated with the positive effect of the production of electricity from RES. Guarantees of origin confirm the origin of electricity produced from RES by:

- a business entity that produces electricity from RES,
- by a consumer who has installed a generating unit for his own consumption, or
- an active consumer.

The guarantee of origin is issued for the volume of 1 MW•h of electricity from RES, released into the network or produced and used for own consumption. The guarantee of origin is formed automatically in a special register and is issued free of charge in accordance with the procedure for issuance, circulation and repayment, which is approved by the Cabinet of Ministers of Ukraine. NEURC is the body responsible for issuing, circulating and redeeming guarantees of origin and ensuring the functioning of the register of guarantees of origin.

The circulation of the guarantee of the origin of electricity from RES is carried out within 12 months from the date of its production. At the same time, the owner of the guarantee of origin has the right to repay it within 18 months from the date of production of the corresponding amount of electricity. The purchase and sale of guarantees of origin of electricity produced from renewable energy sources is carried out on a market basis at free prices. Export and import of guarantees of origin of electricity produced from renewable energy sources is carried out under foreign economic agreements (contracts). However, in order to realize export opportunities, it is necessary to ensure full compliance of the guarantee of origin mechanism with European standards. For this purpose, among the tasks of the National Energy Regulatory Commission of Ukraine, the Law of Ukraine includes ensuring the integration of the register of guarantees of the origin of electricity from RES with the registers of the countries of the Energy Community, the European Union and the Organization for Economic Cooperation and Development. In addition, the European Commission, together with the Secretariat of the Energy Community, is developing a road map for bringing the legislation of the Contracting Parties of the Energy Community, which are not members of the European Union, into compliance with the requirements of the European Union legislation. Thus, full recognition of Ukrainian guarantees of origin in the EU will be possible only after ensuring the integration of the Ukrainian and European registers of guarantees of origin and the fastest possible implementation of the road map requirements.

The Cabinet of Ministers of Ukraine adopted Resolution No. 227 of February 27, 2024 "On the Introduction of Guarantees of Origin of Electricity Produced from Renewable Energy Sources"¹⁹¹ (Official Gazette of Ukraine, 2024, No. 26, Article 1653), which approved the Procedure of issuance, circulation and repayment of guarantees of origin of electricity produced from renewable energy sources and the Procedure for determining the ecological value of electricity produced from renewable energy sources.

In addition, in accordance with the requirements of the Law of Ukraine of June 30, 2023 No. 3220-XX "On Amendments to Certain Laws of Ukraine Regarding the Restoration and "Green" Transformation of the Energy System of Ukraine", the NEURC adopted the following resolutions:

- No. 2624 "On approval of the Procedure for the establishment and maintenance of the register of power facilities and electrical installations of consumers (including active consumers) that use alternative energy sources for the production of electricity" of December 27, 2023, which provides for the introduction of a respective register of generating facilities of producers and consumers, the information from which will be a component of the register of guarantees of origin for electricity from RES. On March 25, 2024, the NEURC published the relevant register for public access;
- No. 2626 "On the approval of the Procedure for disclosure of information to consumers of electricity about energy sources, in the general structure of the balance of electricity purchased by the electricity supplier and/or produced at its own electrical installations" of December 27, 2023, which is necessary for the introduction of the mechanism of guarantees of origin.

¹⁹¹ <https://zakon.rada.gov.ua/laws/show/227-2024-%D0%BF#Text>

The Law of Ukraine of June 30, 2023 No. 3220-XX "On Amendments to Certain Laws of Ukraine Regarding the Restoration and "Green" Transformation of the Energy System of Ukraine" determined that the National Energy Regulatory Commission within six months from the date of approval of the procedure for issuing, circulating and repaying guarantees of origin for electricity from RES, should ensure the functioning of the registry of guarantees of origin for electricity from RES. Thus, it is expected that the register of guarantees of origin of electricity from RES will be operational from 2024.

In accordance with the provisions of the Law of Ukraine of June 30, 2023 No. 3220-IX "On Amendments to Certain Laws of Ukraine Regarding the Restoration and "Green" Transformation of the Energy System of Ukraine", within six months from the date of approval by the Cabinet of Ministers of Ukraine of the procedure for issuance, circulation and redemption of guarantees of the origin of electricity produced from renewable energy sources, the functioning of the registry of guarantees of the origin of electricity produced from renewable energy sources must be ensured. Considering that the Cabinet of Ministers of Ukraine adopted Resolution No. 227 "On the introduction of guarantees of the origin of electricity produced from renewable energy sources" (Official Gazette of Ukraine, 2024 p., No. 26, Article 1653) on February 27, 2024, the full functioning of the register of guarantees of origin of electricity produced from renewable energy sources in Ukraine should start no later than August 27, 2024. At the same time, the Government, with the involvement of all interested parties, needs to develop and implement mechanisms to stimulate the domestic market of guarantees of origin.

It is expected that the introduction of an effective system of guarantees of the origin of electricity from RES will be a significant impetus for the development of the RES sector in Ukraine and will create prerequisites for the export of "green" electricity.

PM_D_WAM_15 Mandatory use of liquid biofuel (biocomponents) in the field of transport, which meets sustainability criteria

Objective: development of production, circulation and use of sustainable liquid biofuel in transport.

Legal basis: Energy Strategy of Ukraine for the period until 2050, Directive (EC) 2018/2001 on the promotion of energy production from renewable sources

Time frame: from 2024

Responsible bodies/organizations: Ministry of Infrastructure, SAEE, State Environmental Inspectorate, Ministry of Energy

Description: The introduction of mandatory use of liquid biofuel (biocomponents) in the field of transport will contribute to:

- increasing the workload of distilleries and the production potential of adjacent areas;
- creation of new jobs;
- improvement of the environmental conditions due to the reduction of emissions into the atmosphere of harmful substances released during the combustion of fossil fuels;
- creation of prerequisites for attracting foreign and domestic investments in the field of production of liquid biofuel (biocomponents).

The Verkhovna Rada of Ukraine has registered a draft Law of Ukraine "On Amendments to Certain Legislative Acts of Ukraine Regarding Mandatory Use of Liquid Biofuel (Biocomponents) in the Transport Industry" (Reg. No. 3356-d of November 5, 2020), which was adopted in the second reading, and provides for the establishment of a regulatory framework for the development of the area of production, circulation and use of liquid biofuel in transport and the establishment of a mandatory share of the use of biofuel in the field of transport. In addition, the draft law provides for the introduction of sustainability criteria for liquid biofuel (biocomponents) and biogas intended for use in the transport sector. At the same time, the implementation of the system of sustainability criteria for all types of biofuels, bioliquids and fuels from biomass is envisaged within the framework of the draft law on the implementation of Directive 2018/2001, which is being developed by the Ministry of Energy.

PM_D_WAM_16 Implementation of unified electronic trade in solid biofuels

Objective: development of the solid biofuels market by creating a single electronic platform for trading in solid biofuels

Legal basis: Energy Strategy of Ukraine for the period up to 2050

Time frame: from 2025.

Responsible bodies/organizations: Ministry of Infrastructure, SAEE, Ministry of Energy.

Description: Today, the solid biofuel market has a number of problems, including the instability of biofuel prices, low quality, and unreliable supply. The mechanism for organizing the biofuel market in Ukraine should be the use of an electronic platform (exchange), where all interested producers and consumers will trade biofuel.

A package of draft laws has been registered in the Verkhovna Rada of Ukraine, which provides for the establishment of legislative prerequisites for the introduction of electronic trade in solid biofuels, namely:

- the draft Law of Ukraine "On Amendments to Certain Legislative Acts of Ukraine Regarding the Development of Electronic Trade in Alternative Fuels" (Reg. No. 8052 of September 19, 2022), which, in particular, provides for the creation of legislative prerequisites for the introduction of electronic trade in solid alternative fuels¹⁹²;
- the draft Law of Ukraine "On Amendments to the Code of Ukraine on Administrative Offenses Regarding Liability for Offenses in the Field of Electronic Trade in Alternative Fuels" (Reg. No. 8053 of September 19, 2022).

Introduction of a solid biofuel trade exchange will enable establishment a transparent and competitive biofuel market in Ukraine; will contribute to the reduction of biofuel prices; will provide generating capacity with biofuel; will stimulate investment attraction in bioenergy of Ukraine.

PM_D_WAM_17 Development of the energy crops sector

Objective: establishment of prerequisites for simplifying the economic activity on growing energy crops.

Legal basis: Energy Strategy of Ukraine for the period up to 2050

Time frame: from 2025

Responsible bodies/organizations: Ministry of Agrarian Policy, Ministry of Energy, Ministry of Finance, Ministry of Infrastructure, SAEE

Description: A promising renewable source for thermal energy production is energy crops, which are grown on low-productivity lands and can be resistant to arid conditions and require less or no chemical pesticides.

Energy crops sector in Ukraine is at the initial stage of development, which is associated with a number of barriers that prevent such development, in particular of a legislative nature (the absence of the term "energy crops" in the legislation of Ukraine, the complicated procedure for leasing state and communal land), administrative (short term land lease agreements, lack of a civilized biomass market) and financial (need to attract significant investments at the initial stages of planting energy crops plantations, long payback period of projects).

At the same time, the cultivation of energy crops has a significant potential for strengthening the energy independence of Ukraine and the development of renewable energy sources by replacing the use of natural gas in the production of heat and electricity.

¹⁹² <https://itd.rada.gov.ua/billInfo/Bills/Card/40449>

The implementation of projects on the cultivation of energy crops has a number of positive consequences, in particular:

- development of a new type of economic activity and domestic biofuel market;
- reduction of greenhouse gas emissions due to the use of CO₂-neutral fuel and replacement of fossil fuels with biomass;
- obtaining profit from unproductive or degraded agricultural lands and restoring their fertility;
- cleaning of contaminated land;
- creation of new jobs and generating tax revenue to budgets of all levels, socio-economic stability of regions.

In order to ensure the possibility of using the potential of unproductive lands for the cultivation of energy crops and their further use in the energy sector, the People's Deputies of Ukraine developed a package of draft Laws of Ukraine:

- "On Amendments to Some Legislative Acts of Ukraine Regarding Promotion of the Development of Energy Crops" (Reg. No. 5227 of March 12, 2021)¹⁹³;
- "On Amendments to Article 288 of the Tax Code of Ukraine regarding rent for land plots on which energy plants are grown" (reg. No. 5228 of March 12, 2021)¹⁹⁴.

The main provisions of the bills are:

- establishment of the maximum amount of rent for land plots of state and communal property at the level of 5% of the normative monetary assessment;
- introduction of the minimum lease term for land plots provided for the cultivation of energy crops - 20 years;
- lease of unproductive and marginal land plots of state and communal property (without holding land auctions);
- providing a definition of the term "energy crops" and introducing state support for the cultivation of energy crops.

PM_D_WAM_18 Simplification of permit procedures for RES projects

Objective: Accelerating the development of RES projects.

Responsible bodies: Ministry of Energy, NEURC.

Time frame: until 2030

Legal basis: Law of Ukraine of June 30, 2023 No. 3220-IX "On Amendments to Certain Laws of Ukraine Regarding the Restoration and "Green" Transformation of the Energy System of Ukraine", Energy Strategy of Ukraine for the period until 2050.

Description: Directive of the European Parliament and Council (EC) 2018/2001 of December 11, (revised in 2023) on the promotion of the use of energy from renewable sources provides that in the zones of accelerated development of renewable energy, the time for obtaining permits for new power plants should not exceed one year and six months for repowering projects, including all administrative permits, grid connection permits and environmental impact assessment. EU member states must now treat renewable energy projects as being of "overriding public interest" to speed up any legal challenges.

¹⁹³ http://w1.c1.rada.gov.ua/pls/zweb2/webproc4_1?pf3511=71384

¹⁹⁴ http://w1.c1.rada.gov.ua/pls/zweb2/webproc4_1?pf3511=71385

The principle of overriding public interest, which was introduced in the EU countries, provides for the simplification of procedures for obtaining permits and the introduction of a presumption of feasibility and absence of negative impact on the environment for renewable energy projects, etc.

Today, the procedure for obtaining permit documentation for the implementation of RES projects in Ukraine is complex and long. Project developers are faced with a number of bureaucratic barriers, overcoming which and obtaining all the necessary permits and approvals takes 3-5 years, which is unacceptable given the existing difficult situation in the energy sector of Ukraine, caused by constant shelling of energy infrastructure of Ukraine by the Russian Federation. In order to simplify the permitting procedures, as a first step, it is planned to conduct research on obstacles to accession, adopting legislative changes with a focus on the implementation of EU legislation, in particular Council Regulation (EU) 2022/2577 of December 22, 2022 laying down a framework to accelerate the deployment of renewable energy. In addition, it is planned to consider the following measures:

- Introduce digitalization of registry archives and other information necessary in the process of project development, in particular regarding:
 - objects of archaeological and cultural heritage with their protection zones;
 - detailed plans of territories, urban planning documentation of various levels;
 - the existing road infrastructure with the indication of the main parameters and the plan of repairs/reconstructions;
 - existing environmental studies.
- Extend the validity period of permit documentation to at least 5 years from the moment of its issuance (aviation, environmental impact assessment, agricultural passports, technical conditions, geological and geodetic surveys, etc.).
- To reform approaches to issuing technical conditions for connection to electricity grids:
 - providing the possibility of joint use of already issued and implemented technical conditions;
 - canceling the dependence of the validity period of the contract on connection to electricity grids on the validity period of technical conditions;
 - reservation of technical conditions or technical solutions for a certain period under a financial guarantee.
- Create the possibility of obtaining aviation approvals without reference to urban planning documentation.
- Simplify the permit procedure for Repowering projects, if the object's characteristics increase by no more than 30% (in the absence of a change in the connected capacity).

Simplification of the permitting procedure, early detection of "no-go" risks and identification of sites with the greatest combined potential for the state and the developer of RES projects will help unlock existing projects at the stage of obtaining permits and accelerate the implementation of new projects. Reducing bureaucratic barriers for renewable energy projects will reduce the time and effort required to obtain the necessary permits, which will contribute to a faster start-up and implementation of projects.

ii. Where relevant, specific measures for regional cooperation, as well as, as an option, the estimated excess production of energy from renewable sources which could be transferred to other Contracting Parties and/or Member States of the European Union in order to achieve the national contribution and trajectories referred to in point 2.1.2

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iii. Specific measures on financial support, where applicable for the promotion of the production and use of energy from renewable sources in electricity, heating and cooling, and transport

In 2020, the cost of price support for producers of electricity from RES, which sell generated electricity at the "green" tariff, reached UAH 39,033 million¹⁹⁵. In addition, a number of tax benefits are available

to producers of electricity from RES (described above in PM_D_WEM_04). However, the cost of such support (in the form of uncollected tax revenues to the state budget) of the RES sector has not been assessed in recent years. At the same time, by the end of June 2024, the National Revenue Strategy envisages conducting an inventory of tax benefits and incentives available in Ukraine, providing an assessment of their effectiveness and the justification of their time frames, developing a unified approach to the application of tax incentives in the period from 2025 to 2030, and a plan reforming tax legislation regarding the implementation of such an approach (executors of the measure - Ministry of Finance, State Tax Service, central government bodies)¹⁹⁶.

v. Where applicable, the assessment of the support for electricity from renewable sources that Contracting Parties are to carry out pursuant to Article 6(4) of Directive (EU) 2018/2001, as adapted and adopted by Ministerial Council Decisions 2021/14/MC-EnC and 2022/02/MC-EnC

Not applicable (no assessment)

v. Specific measures to introduce one or more contact points, streamline administrative procedures, provide information and training, and facilitate the uptake of power purchase agreements Summary of the policies and measures under the enabling framework Contracting Parties have to put in place pursuant to Article 21(6) and Article 22(5) of Directive (EU) 2018/2001 as adapted and adopted by Ministerial Council Decisions 2021/14/MC-EnC and 2022/02/MC-EnC, to promote and facilitate the development of self-consumption and renewable energy communities

The current legislation already provides opportunities for the development of decentralized generation based on renewable energy sources and stimulation of self-produced energy consumption. In particular, Law No. 3220-IX introduced aggregation (PM_IME_WAM_02) and support of active consumers using the self-production mechanism (PM_IME_WEM_02), as well as stimulation of the development of distributed generation of electricity from RES for the period up to 2030 (PM_IME_WAM_05) (see in detail section 3.4.3. ii of this Plan). In addition, the concept of RES-communities is planned to be implemented in the draft law on the implementation of Directive 2018/2001, which is currently being developed by the Ministry of Energy.

vi. Assessment of the necessity to build new infrastructure for district heating and cooling produced from renewable sources

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vii. Where applicable, specific measures on the promotion of the use of energy from biomass, especially for new biomass mobilisation taking into account:

- biomass availability, including sustainable biomass: both domestic potential and imports from third countries

- other biomass uses by other sectors (agriculture and forest-based sectors); as well as measures for the sustainability of biomass production and use

Most of the policies and measures described in section 3.1.2 of this Plan above are available to producers of electricity and heat from biomass as well as for producers based on other renewable sources.

¹⁹⁵

<https://www.eu4environment.org/app/uploads/2023/09/Review-of-Energy-Subsidies-in-the-Context-of-Energy-Sector-Reforms-Ukraine-prefinal.pdf>

¹⁹⁶ https://mof.gov.ua/uk/national_income_strategy-716

3.1.3. Other elements of the dimension

i. <...>

ii. Policies and measures to achieve other national targets, where applicable

PM_D_WAM_19 State target program for the just transition of coal regions of Ukraine for the period until 2030

Objective: To overcome the problems of socio-economic development of coal regions due to the closure of coal mining and coal processing enterprises, as well as coal-based thermal power plants.

Legal basis: Resolution of the Cabinet of Ministers of Ukraine of September 22, 2021 No. 1024 "On approval of the Concept of the State target program for the just transition of the coal regions of Ukraine for the period until 2030" (Official Gazette of Ukraine, 2021 p., No. 80, Article 5050).

Time frame: 2025-2030

Responsible bodies/organizations: Ministry of Infrastructure, Ministry of Energy.

Description: The ESU states that the use of coal-based power generation will be reduced until it is completely decommissioned in 2035. In order to overcome the problems of socio-economic development of coal regions due to the closure of coal mining and coal processing enterprises, as well as coal-based thermal power plants, the government approved the Concept of the State target program for the just transition of the coal regions of Ukraine for the period until 2030 on September 22, 2021¹⁹⁷. According to the Concept, coal regions are defined as regions on the territory of which coal mining and coal processing enterprises are located, including those that are in the stage of liquidation, conservation or repurposing to other types of economic activity, and coal-based thermal power plants, regardless of the form of ownership. In total, these are about 20 territorial communities of the Volyn, Dnipropetrovsk, Donetsk, Luhansk and Lviv regions, where about 850,000 residents live.

The concept provided for the development of the draft of the State Target Program for the just transition of the coal regions of Ukraine for the period up to 2030 within a six-month period. However, due to the full-scale invasion of the Russian Federation into Ukraine, the development of the state program was postponed taking into account the impossibility of conducting an assessment of the condition of flooded mines in the temporarily occupied territories, as well as military actions and the complete destruction of the infrastructure of the settlements of coal territorial communities.

PM_D_WAM_20 Implementation of climate change adaptation measures at the national and local levels

Objective: Increasing the level of environmental security, reducing the effects and consequences of climate change in Ukraine.

Legal basis: Decree of the Cabinet of Ministers of Ukraine of October 20, 2021 No. 1363 "On the approval of the Strategy for Environmental Security and Adaptation to Climate Change for the Period Until 2030" (Official Gazette of Ukraine, 2021 p., No. 87, Article 5584).

Time frames: 2021 - 2030

Responsible bodies/organizations: Ministry of Environment

¹⁹⁷ <https://zakon.rada.gov.ua/laws/show/1024-2021-%D0%BF#Text>

Description: In order to achieve the goal of **strengthening the adaptive capacity and resilience of social, economic and ecological systems to climate change**, the Strategy for Environmental Security and Adaptation to Climate Change for the period until 2030¹⁹⁸ defines a number of tasks, in particular:

- conducting sectoral studies on risk assessment, vulnerability and climate change forecasting in the areas of water resources management, biodiversity conservation, forest fund, energy, public health, agriculture, soil protection, transport and infrastructure, tourism;
- development of action plans for adaptation to climate change in the areas of water resources management (within the river basin management plan), preservation of biodiversity, forest resources, energy, public health, agriculture, soil protection, transport and infrastructure, tourism;
- ensuring that the current and projected consequences of climate change are taken into account in strategic planning at the national, regional and local levels, as well as during the construction of infrastructure facilities;
- revision of state construction regulations taking into account the current and projected consequences of climate change;
- strengthening the resistance of forest ecosystems to pests and new climatic conditions, implementing measures to prevent and quickly respond to fires;
- technical improvement and ensuring the development of hydrometeorological observation and forecasting systems;
- conducting a financial assessment of climate change adaptation measures.

The implementation of the Strategy will be carried out through the implementation of measures defined by the operational plans, which will be approved by the orders of the Cabinet of Ministers of Ukraine for a three-year period, as well as the National Action Plan for the Protection of the Natural Environment for the period until 2025, approved by the order of the Cabinet of Ministers of Ukraine of April 21, 2021 No. 443 (Official Gazette of Ukraine 2021, No. 42, Article 2557)¹⁹⁹.

Thus, the operational plan for the implementation of the Strategy in 2022-2024 provides for the implementation of 28 measures, in particular, the preparation of studies and recommendations for the integration of adaptation issues into strategic documents at the local and national level, conducting risk and vulnerability assessments to climate change of various socio-economic sectors, and the development of sectoral plans of adaptation measures, development of regional and local strategies for adaptation to climate change or inclusion of issues of adaptation to climate change in regional development strategies, development strategies of territorial communities and plans of measures for their implementation, as well as in economic and social development programs of regions, districts, cities etc.

The implementation of the Strategy should ensure the achievement of the goal and strategic goals, in particular, with regard to strengthening the adaptive capacity and resilience of social, economic and ecological systems to climate change.

¹⁹⁸ <https://zakon.rada.gov.ua/laws/show/1363-2021-%D1%80#Text>

iii. Policies and measures to achieve low emission mobility (including electrification of transport)

PM_D_WEM_08 Tax benefits for vehicles equipped with electric motors

Objective: Stimulating the production and use of vehicles equipped with electric motors.

Legal basis: Tax Code of Ukraine, Customs Code of Ukraine, Law of Ukraine "On the Compulsory State Pension Insurance Fee"²⁰⁰, Law of Ukraine "On Customs Tariff of Ukraine"²⁰¹

Time frame: from 2018

Responsible bodies/organizations: Ministry of Finance, State Tax Service, State Customs Service.

Description: The Tax and Customs Codes of Ukraine provide for a number of tax benefits to encourage the use of electric passenger cars, which were introduced in 2018 and have been extended several times. In particular, no customs duty is charged on the import of electric vehicles, and transactions involving importation into the customs territory are also exempt from VAT (Clause 64 of Subsection 2 of Chapter XX of the Tax Code of Ukraine) until 2026. In addition, the excise tax rate for electric cars is much lower than for cars with internal combustion engines or hybrid cars - 1 EUR per 1 kW·h of battery capacity.

From July 1, 2022, electric passenger cars are also exempted from payment of mandatory state pension insurance fee upon first registration in accordance with the Law of Ukraine "On the Compulsory State Pension Insurance Fee".

In order to stimulate the domestic production of electric vehicles, from January 1, 2022 to January 1, 2031, import of goods into the customs territory, which are used for the own production of transport vehicles equipped exclusively with electric motors, are exempted from import duties in accordance with the Customs Code of Ukraine and VAT taxation in accordance with the Tax Code of Ukraine. In addition, from January 1, 2022 to December 31, 2035, the profit of enterprises engaged exclusively in the production of electric motors, as well as manufacturers of lithium-ion (lithium-polymer) batteries and chargers intended for vehicles, equipped exclusively with electric motors, as well as manufacturers of vehicles equipped exclusively with electric motors is exempted from taxes in accordance with the Tax Code of Ukraine.

At the same time, the released funds (tax amounts that are not paid to the budget and remain at the disposal of the taxpayer) must be used for research and development work in the field of electric transport, establishment or re-equipment of the material and technical base, increase in the volume of production, introduction of the latest technologies.

According to the estimates of the Ministry of Finance ²⁰², the expected amount of the tax revenue foregone in 2022 in connection with the provided tax benefits is:

- in connection with the exemption from VAT of operations on the supply to the customs territory of Ukraine of vehicles equipped exclusively with electric motors - about UAH 364 million;
- in connection with the exemption from taxation of the profit of enterprises that are exclusively engaged in the production of electric motors intended for vehicles equipped exclusively with electric motors and electric vehicles - UAH 584 million.

¹⁹⁹ <https://zakon.rada.gov.ua/laws/show/443-2021-%D1%80#n12>

²⁰⁰ <https://zakon.rada.gov.ua/laws/show/400/97-%D0%B2%D1%80/ed20231208#Text>

²⁰¹ <https://zakon.rada.gov.ua/laws/show/2697-20#n9>

The effectiveness of the above mentioned tax benefits was not evaluated purposefully. However, the number of electric cars increased from 7,439 units in 2018 (as of May 1) ²⁰³ to 85,881 units in 2023 (at the end of the year) ²⁰⁴, that is, more than ten times, which may indirectly indicate the effectiveness of fiscal stimulation of development sector of vehicles equipped with electric motors.

At the same time, the National Revenue Strategy until 2030 provides for the development of a unified approach to the application of tax incentives in the period from 2025 to 2030 and a plan to reform the tax legislation to implement such an approach.

PM_D_WEM_09 Stimulating the development of electric charging infrastructure

Objective: Reducing the consumption of fossil fuels by the transport sector

Legal basis: Law of Ukraine of February 24, 2023 No. 2956-IX "On some issues of the use of vehicles equipped with electric motors and amendments to some laws of Ukraine regarding overcoming fuel dependence and development of electric charging infrastructure and electric vehicles."

Time frame: from 2023.

Responsible bodies/organizations: Ministry of Infrastructure, Ministry of Energy, JSC "NNEGC "Energoatom"

Description: In March 2023, the Law of Ukraine of February 24, 2023 No. 2956-IX "On some issues of the use of vehicles equipped with electric motors and amendments to some laws of Ukraine regarding overcoming fuel dependence and development of electric charging infrastructure and electric transport" entered into force. In accordance with this Law, ensuring the development of electric vehicles and the infrastructure of charging stations for electric vehicles is a priority for the development of state policy in the field of road transport. The concept of an electric car covers both an electric passenger car and an electric truck, equipped exclusively with electric motors (one or several) and an electricity storage system.

According to current construction standards, at least 5% of the total number of parking spaces in parking lots must be provided for parking of electric vehicles. Such places can be equipped with charging stations ²⁰⁵.

In accordance with the Law of Ukraine of February 24, 2023 No. 2956-IX "On some issues of the use of vehicles equipped with electric motors and amendments to some laws of Ukraine on overcoming fuel dependence and development of electric charging infrastructure and electric vehicles" state authorities and by December 31, 2023, local self-government bodies must approve programs for the development of electric charging infrastructure, which will provide for the provision of state-owned or communal facilities with charging stations for electric cars in existing parking lots, garages and other parking spaces (except for those used exclusively by such bodies, or state or communal enterprises, institutions, organizations) in accordance with construction standards. In accordance with such programs, state and communal commercial enterprises, state owned enterprises must provide existing objects owned by such entities or secured by them with the right of economic ownership, with the necessary contractual capacity and electric vehicle charging stations in existing parking lots, garages and other parking spaces (except those used exclusively by such entities) by December 31, 2024.

²⁰² <https://itd.rada.gov.ua/billInfo/Bills/pubFile/1473870>

²⁰³ https://texty.org.ua/fragments/85448/Skilky_de_ta_jakyh_jelekromobiliv_v_Ukrajini-85448/

²⁰⁴ <https://kompek.rada.gov.ua/uploads/documents/31243.pdf>

²⁰⁵ DBN V.2.3-15:2007. Parking lots and garages for cars. https://e-construction.gov.ua/laws_detail/2845786368808847244?doc_type=2

The Law of Ukraine on electric transport stipulates that projects of new construction of multi-story residential buildings must take into account the need to provide at least 50% of parking spaces for electric vehicles with charging stations. The development of electric charging infrastructure for existing buildings is also foreseen: associations of co-owners of apartment buildings have the right to install charging stations on the premises and independently determine the procedure for using and paying for such stations.

In addition, it is planned to transpose Commission Delegated Regulation (EU) 2019/1745 of August 13, 2019 supplementing and amending Directive 2014/94/EU of the European Parliament and of the Council as regards recharging points for L-category motor vehicles, shore-side electricity supply for inland waterway vessels, hydrogen supply for road transport and natural gas supply for road and waterborne transport and repealing Commission Delegated Regulation (EU) 2018/674.

PM_D_WEM_10 Stimulating the development of low-carbon municipal transport

Objective: Reducing the consumption of fossil fuels by the transport sector

Legal basis: Law of Ukraine of February 24, 2023 No. 2956-IX "On some issues of the use of vehicles equipped with electric motors and amendments to some laws of Ukraine regarding overcoming fuel dependence and development of electric charging infrastructure and electric vehicles."

Time frames: 2023-2036

Responsible bodies/organizations: Ministry of Infrastructure

Description: The Law of Ukraine "On Urban Electric Transport" provides for the gradual replacement of municipal transport with low-carbon alternatives. On city bus routes in cities with a total population of more than 250,000 people, the share of electric buses and/or buses running exclusively on methane (compressed or liquefied) or biogas, and/or buses with a hydrogen fuel cell in the fleet buses should be at least:

- 25% on January 1, 2030;
- 50% on January 1, 2033.

In addition, from January 1, 2036, only electric buses or buses running exclusively on methane (compressed or liquefied) or biogas and/or buses with a hydrogen fuel cell are allowed to transport passengers on public city bus routes in the mode of regular passenger transportation in cities of district and regional significance.

At the same time, local self-government bodies have the right to revise these shares (but not more than by 50%) and terms (not more than by two years).

From January 1, 2028, gradual restrictions will be imposed on the purchase of buses with internal combustion engines for use in the field of public transport.

3.2. Dimension energy efficiency

Planned policies, measures and programmes to achieve the indicative national energy efficiency contributions for 2030 as well as other objectives referred to in point 2.2, including planned measures and instruments (also of a financial nature) to promote the energy performance of buildings, in particular with regard to the following:

i. Energy efficiency obligation schemes and alternative policy measures under Articles 7a and 7b and Article 20(6) of Directive 2012/27/EU as adapted and adopted by Ministerial Council Decisions 2015/08/MC-EnC, 2021/14/MC-EnC and 2022/02/MC-EnC, and to be prepared in accordance with Annex III to this Regulation

The Law of Ukraine "On Energy Efficiency" provides for an alternative approach to the implementation of Article 7 of Directive 2012/27/EU. Achieving the target indicator of annual energy consumption reduction is ensured by the following ways:

- implementation of activities by the Energy Efficiency Fund and other funds;

- implementation of state target programs in the field of ensuring energy efficiency;
- adoption of standards, norms and rules for improving the energy efficiency of goods and services, including buildings and vehicles, the requirements of which exceed the requirements of European standards, norms and rules that are mandatory in accordance with the legislation of the European Union, decisions of the Energy Community;
- introduction of requirements for energy labeling and eco-design of energy-consuming products, for which no requirements have been established in accordance with the norms of legislation of the European Union, decisions of the Energy Community;
- implementation of other measures, the result of which is the provision of an annual reduction in energy consumption.

Within the framework of the implementation of this policy, the following tools are available or planned: PM_EE_WEM_01 Activities of the Energy Efficiency Fund; PM_EE_WEM_02 State Fund for Decarbonisation and Energy Efficient Transformation; PM_EE_WAM_01 Scheme of obligations on energy efficiency; PM_EE_WAM_02 Implementation of the State targeted economic program to support thermal modernisation of buildings until 2030; PM_EE_WAM_10 Implementation of the State targeted economic program for the energy modernisation of state-owned or communally owned heat energy producing enterprises for the period up to 2030.

PM_EE_WEM_01 Activities of the Energy Efficiency Fund

Goal: Support for energy efficiency initiatives, implementation of incentive tools and support for measures to increase the level of energy efficiency of buildings and energy saving, in particular in the residential sector

Legal basis: Law of Ukraine "On the Energy Efficiency Fund".

Time frames: 2018 - indefinitely.

Responsible bodies/organizations: Energy Efficiency Fund, Ministry of Infrastructure.

Description:

a) Energodym program

The Fund provides partial reimbursement of costs for measures to increase energy efficiency in accordance with the "Energodym" Fund Program.

According to the Law of Ukraine "On the Energy Efficiency Fund", the Fund provides grants exclusively to homeowners' associations of multi-apartment buildings (HOAs).

The creation of HOAs is not mandatory in Ukraine. According to the State Statistics Service, as of January 1, 2024, 39,709 ²⁰⁶ HOAs were registered, while the total number of multi-apartment buildings is about 180,000. In accordance with the Law of Ukraine of July 14, 2023 No. 3270-IX "On Amendments to Certain Laws of Ukraine on Simplifying the Management of Multi-apartment Buildings", as a general rule, a HOA decision is adopted if it is voted for by homeowners, which together have more than half of the total number of votes of all homeowners. The HOA may increase the required number of votes (up to 67 percent of the total number of votes of all homeowners) to adopt decisions on the following issues: election of association management bodies, change of management form, establishment and change of the amount of contributions/payments, budget approval.

²⁰⁶ https://www.ukrstat.gov.ua/edrpy/ukr/EDRPU_2024/ks_opfg/ks_opfg_s_0124_ue.xls

Beneficiaries of the Fund can choose one of two packages of energy efficiency measures to implement in their home, “Light” or “Comprehensive”.

The "Light" package (Package A) includes the following mandatory measures:

- installation of a heat meter;
- installation or modernisation of an individual heat sub-station (IHS).

Additionally, HOAs can receive partial reimbursement of the cost of implementing additional measures determined by the Energodim Program.

The "Comprehensive" package (Package B) includes the following mandatory measures:

- mandatory measures for Package A;
- thermal insulation and/or replacement of pipelines of the internal heat supply system and hot water supply system in the unheated premises;
- installation of automatic (balancing) valves;
replacement or repair of external doors and/or arrangement of external entrance vestibules;
replacement or repair of windows in common areas of the building.

Similarly to Package A, condominiums have the opportunity to receive a grant for the implementation of additional (optional) measures defined by the Program. The amount of partial reimbursement of the cost of energy efficiency improvement measures (grant) differs depending on the time of application submission (increased grant amount for the first 500 applications) and the selected package of measures. The current amounts of grants are:

- 70% of the cost of the preliminary energy audit; development of project documentation and its examination; technical and copyright supervision services; certification of energy efficiency after the implementation of the project and inspection of the engineering systems of the building, on which energy efficiency improvement measures were implemented during the implementation of the project - for both packages of measures;
- 40% of the cost of works, equipment, materials - for Package A
- 50% of the cost of works, equipment, materials - for Package B.

The government plans to gradually reduce the share of reimbursement for energy efficiency measures after the termination/revocation of martial law ²⁰⁷.

Grants are provided by the Energy Efficiency Fund in separate tranches, after the implementation of the relevant stage of the project and its verification by the Fund. Condominiums can receive a partial advance for construction works, provided that it is confirmed that the contractors selected by the condominium meet the requirements of the Fund established in the Energodim Program.

Results: As of December 15, 2023, construction works on 316 projects of the Fund were fully or partially completed. The cumulative value of the achieved energy savings is 315.2 million kWh/year, the cumulative value of CO2 emission reduction is 84.8 thousand tons/year ²⁰⁸. Achieving an annual increase in the energy efficiency of energy consumption due to the activities of the Energy Efficiency Fund largely depends on sustainable state funding. At the same time, expenses for the functioning of the Energy Efficiency Fund were not provided for in the State Budget for 2020, 2023-2024. For 2018-2026, the Energy Efficiency Fund plans to implement more than 800 projects and expects that another 300 projects will be at the implementation stage. The expected reduction of CO2 emissions is more than 120,000 tons/year ²⁰⁹.

²⁰⁷ Operational plan of measures for the implementation in 2024-2026 of the Long-term strategy of thermal modernisation of buildings for the period until 2050. <https://zakon.rada.gov.ua/laws/show/1228-2023-p#Text>

²⁰⁸

<https://eefund.org.ua/wp-content/uploads/2024/01/strategiya-fondu-energoefektyvnosti-2024-2026-povna-versiya-1.pdf>

²⁰⁹ Ibid

Planned measures: The government also plans to expand the areas of activity of the Energy Efficiency Fund by directing funding to:

- measures aimed at increasing the share of energy produced from renewable energy sources;
- measures aimed at increasing the number of buildings with close to zero energy consumption;
- energy-efficient measures in private (manor) houses.

Corresponding changes to the Energy Efficiency Fund Program will be introduced in the IV quarter of 2024.²¹⁰

Among the measures in the direction of "Energy poverty reduction" in the phase up to 2025, the ESU provides for the study of the feasibility of introducing subsidies for the implementation of small energy renovations for vulnerable households on the principle of "first in line for repairs", with priority given to vulnerable consumers. It is advisable to carry out such an analysis as part of the assessment of options for expanding the financing of the Energodym Program of the Energy Efficiency Fund. According to the ESU, the introduction of energy-efficient measures will be stimulated by subsidizing vulnerable categories of consumers, providing grants and low-interest loans for a defined group of households (those with a low level of income) until 2032.

Currently, the Fund is concentrating on the implementation of individual projects, however, in the II quarter of 2024, the pilot project of thermal modernisation of a residential quarter (the "Energy-efficient district of Lviv" project), which is implemented by the Energy Efficiency Fund with the support of GIZ, is expected to be completed. This approach will make it possible to operationalize the principle of "energy efficiency first" and ensure complex synergistic thermal modernisation of buildings, heat networks and heat-generating equipment.

b) Vidnovydim program

In August 2022, the Law of Ukraine "On the Energy Efficiency Fund" was amended, which allowed the Fund to finance not only energy efficiency measures, but also programs related to the restoration of buildings destroyed and/or damaged as a result of armed aggression. From November 2022, the new Program of the Fund - Vidnovydim began to operate. The participants of this Program are also exclusively HOAs. Funding under the Vidnovydim Program is provided for the following types of work (services):

- replacement or repair of damaged windows, external and internal vestibule doors;
- repair of damaged building facades;
- repair of damaged roof structures / building covering;
- repair of damaged equipment of roof boiler houses and engineering networks.

Financing is provided for the implementation of construction works, as well as the purchase of materials and equipment necessary for the performance of such works. Such financing is provided in the form of a grant in the amount of 100% of the costs of the implementation of eligible measures under the project, with a cap not exceeding UAH 7.2 million.

Results: As of December 15, 2023, construction works on 211 projects of the Fund have been fully or partially completed²¹¹.

²¹¹

<https://eefund.org.ua/wp-content/uploads/2024/01/strategiya-fondu-energoefektyvnosti-2024-2026-povna-versiya-1.pdf>

PM_EE_WEM_02 Decarbonisation and Energy-Efficient Transformation Fund

Goal: Co-financing of projects (measures) leading to reduction of CO2 emissions.

Legal basis: Budget Code of Ukraine.

Time frames: 2023. - indefinitely.

Responsible bodies/organizations: Ministry of Infrastructure, State Agency on Energy Efficiency and Energy Saving (SAEE).

Description: In May 2023, amendments to the Budget Code of Ukraine entered into force, creating the State Fund for Decarbonisation and Energy-Efficient Transformation (Decarbonisation Fund) as a separate budget program as part of a special fund of the State Budget of Ukraine. The funds of the Decarbonisation Fund will be directed to:

- financing of measures and state target programs in the field of energy efficiency, increasing the use of RES and alternative fuels and reducing CO2 emissions;
- financing of compensation, compensation, reduction in the price of obligations of individuals and legal entities under credit and leasing agreements concluded for the implementation of energy efficiency measures, implementation of energy service, increased use of RES and alternative fuels and reduction of CO2 emissions;
- fulfillment of debt obligations for borrowing received by the state for the implementation of investment projects in the field of energy efficiency, increasing the use of RES and alternative fuels and reducing CO2 emissions.

The Decarbonisation Fund will be replenished at the expense of deductions from the tax on CO2 emissions (a component of the environmental tax), state borrowing and other revenues. The state budget for 2024 provides for financing of the Decarbonisation Fund in the amount of UAH 759.2 million. The mechanism for providing funds from the Decarbonisation Fund and the details of possible financing measures must be regulated by the Procedure for using funds from the State Fund for Decarbonisation and Energy Efficient Transformation, approved by the Cabinet of Ministers of Ukraine.

Energy savings achieved as a result of the implementation of measures funded by the Decarbonisation Fund can be taken into account when determining the cumulative end-use energy savings if a monitoring and verification system is implemented that will meet the requirements of Directive 2012/27/EU.

Results: Planned policy.

PM_EE_WAM_01 Energy efficiency obligation scheme

Goal: Implementation of energy-efficient measures under market conditions.

Legal basis: Law of Ukraine "On Energy Efficiency".

Time frames: Within the period determined by the Cabinet of Ministers of Ukraine.

Responsible bodies/organizations: Ministry of Infrastructure, SAEE.

Description: The Law of Ukraine "On Energy Efficiency" provides for the possibility of introducing an energy efficiency obligation scheme (EEOS). The relevant provisions can be activated by the Cabinet of Ministers of Ukraine in accordance with the following stages:

- 1) The Cabinet of Ministers of Ukraine approves the target indicator for the annual reduction of energy consumption (hereinafter referred to as the target indicator);
- 2) To achieve the target indicator, organisational, economic, and legal measures to stimulate energy efficiency are carried out, the Energy Efficiency Fund operates, and other mechanisms may be implemented;
- 3) SAEE monitors and evaluates the achievement of the target indicator;

- 4) In the event of non-achievement of the target indicator, SAEЕ notifies the Cabinet of Ministers of Ukraine;
- 5) The Cabinet of Ministers of Ukraine decides on the introduction of the procedure for the operation of the EEOS.

The Law of Ukraine "On Energy Efficiency" defines the obligated parties as electricity suppliers and natural gas suppliers. Obligated parties may fulfill the scheme's requirements by:

- implementing eligible energy efficiency measures at the level of final energy consumers;
- involving energy service providers and other business entities to implement energy-efficient measures;
- paying contributions to the Energy Efficiency Fund.

Lists of eligible measures within the scheme of energy efficiency obligations, determination of target indicators for achieving energy consumption reduction for individual obligated parties, and the procedure for monitoring achieved energy consumption reduction will be regulated by secondary legislation.

Expected cumulative and annual amount of energy savings and duration of the period(s) of the energy efficiency obligation scheme, target sectors, share of energy savings to be achieved in energy poverty households, amount of energy savings achieved by energy service providers or by other third parties, the possibilities of attracting loan funds are currently not defined, since the energy efficiency obligation scheme has not been implemented.

Provided that a proper system for monitoring and verifying energy savings is in place, the following measures may also contribute to achieving the target indicator for the total amount of energy saved in end use: **PM_EE_WAM_02 Implementation of the State Targeted Economic Program of Support for Thermal Modernisation of Buildings until 2030** and **PM_EE_WAM_10 Implementation of the State Targeted Economic Program of Energy Modernisation of Heat Producers for the period until 2030**.

ii. Long-term renovation strategy to support the renovation of the national stock of residential and non-residential buildings, both public and private, including policies, measures and actions to stimulate cost-effective deep renovation and policies and actions to target the worst performing segments of the national building stock, in accordance with Article 2a of Directive 2010/31/EU as adapted and adopted by Ministerial Council Decisions 2010/02/MC-EnC, and 2021/14/MC-EnC

PM_EE_WAM_02 Implementation of the State Targeted Economic Program to Support Thermal Modernisation of Buildings by 2030

Goal: Achievement of long-term goals in improving the energy efficiency of buildings.

Legal basis: Law of Ukraine "On Energy Efficiency of Buildings"; Long-term Strategy for thermal modernisation of buildings for the period until 2050; The concept of the State targeted economic program to support thermal modernisation of buildings until 2030, approved by the order of the Cabinet of Ministers of Ukraine of December 29, 2023 No. 1228 "Some issues of strategic development of the energy efficiency of buildings" (Official Gazette of Ukraine, 2024 p., No. 13, Article 843) .

Time frames: 2024-2030

Responsible bodies/organizations: Ministry of Infrastructure, SAEЕ.

Description: To achieve the goals of the first stage of the Long-Term Strategy for the Thermal Modernisation of Buildings up to 2050, the Cabinet of Ministers of Ukraine approved ²¹² Concept of the State Targeted Economic Program of Support for Thermal Modernisation of Buildings until 2030 (hereinafter referred to as the Concept of the Program for Thermal Modernisation of Buildings 2030).

The Concept of the Program for Thermal Modernisation of Buildings 2030 outlines the following tasks:

- **Task 1.** Stimulating an increase in energy efficiency in the residential sector;

- **Task 2.** Ensuring the exemplary role of central and local executive authorities in enhancing the energy efficiency of buildings;
- **Task 3.** Implementing energy management systems in line with international ISO 50000 series standards;
- **Task 4.** Ensuring proper collection and analysis of data on energy and operational characteristics of buildings;
- **Task 5.** Facilitating related construction works to support the implementation of thermal modernisation of buildings;
- **Task 6.** Promoting sanitary and epidemic safety in buildings alongside energy savings;
- **Task 7.** Creating favorable market environment for thermal modernisation of buildings;
- **Task 8.** Stimulating the development of the energy service as an investment mechanism for thermal modernisation of buildings;
- **Task 9.** Increasing public awareness regarding the possibilities of thermal modernisation of buildings;
- **Task 10.** Stimulating local self-government bodies to increase the level of energy efficiency of buildings;
- **Task 11.** Ensuring the development of competencies and qualifications in the field of increasing the energy efficiency of buildings;
- **Task 12.** Supporting scientific, technical, and innovative advancements in improving energy efficiency, including the development of nearly-zero energy buildings.

As part of Task 1 on **increasing the level of energy efficiency in the housing sector**, the Concept proposes expanding the range of support tools for energy efficiency projects. This includes extending support to citizens who own individual houses (currently, support is only available to co-owners of multi-apartment buildings). Specifically, it is planned to reimburse a portion of the loan amount for energy-efficient measures or thermal modernisation, and to provide support for constructing residential buildings with nearly zero energy consumption for owners of properties destroyed as a result of military actions. Additionally, there are plans to assist co-owners in installing heat pumps in the individual heating systems of multi-apartment buildings that are not connected to district heating systems.

²¹² <https://zakon.rada.gov.ua/laws/show/1228-2023-%D1%80#Text>

To **ensure the exemplary role of central and local executive bodies** in increasing the level of energy efficiency of buildings (Task 2), the Concept includes provisions for the certification of the energy efficiency of buildings and the creation of technical passports for state and municipal properties where central executive bodies and other state institutions are located. It also involves implementing energy efficiency measures or thermal modernisation in buildings housing central and local executive authorities, as well as ensuring that the construction (or reconstruction) of state-owned public buildings housing state authorities meets the requirements for nearly-zero energy buildings.

Within Task 3, it is envisaged **to implement energy management systems** taking into account the international standards of the ISO 50000 series in central executive bodies and local state (military) administrations, local self-governments, and encouraging local self-government units to local energy planning.

Task 4 is aimed at **forming an analytical base** in the field of energy efficiency. This task includes conducting a survey of the national stock of residential and public buildings and creating a national database of their energy and operational characteristics. Additionally, the task proposes addressing thermal energy and hot water metering by installing commercial metering units in state-owned buildings and providing incentives for local authorities to install thermal energy distribution metering systems along with automatic air temperature regulators in apartment buildings.

In accordance with Task 5, it is planned to stimulate local self-governments to **carry out related construction works** necessary to comply with state building regulations. This includes ensuring fire safety, lightning protection, and accessibility for people with limited mobility during the thermal modernisation of communally owned and apartment buildings. The task also involves stimulating local authorities to support the execution of construction work needed to address defects in load-bearing and/or enclosing structures that prevent the thermal modernisation of multi-apartment buildings..

To promote **sanitary and epidemic safety of the population** in buildings (Task 6), it is planned to encourage citizens to install mechanical ventilation systems with heat recovery in both multi-apartment and individual residential buildings. Additionally, local authorities will be encouraged to install such systems in public buildings that are communally owned.

Tasks 7 and 8 are aimed at **stimulating business**. They involve providing partial state guarantees and reimbursing part of the interest on loans taken out by micro and small businesses engaged in or planning to engage in the thermal modernisation of buildings. This support is intended to finance the thermal modernisation of buildings and to promote the development of energy-efficient equipment and energy-saving construction products within Ukraine. Additionally, to encourage the growth of the energy service sector, it is planned to reimburse part of the interest on loans taken out by energy service providers for implementing comprehensive thermal modernisation in state and communal buildings, as well as introducing factoring for energy service contracts.

To **increase public awareness** of the possibilities of thermal modernisation of buildings (Task 9), it is envisaged to inform the population and popularize the advantages of thermal modernisation of buildings, programs of state support for thermal modernisation of buildings in the mass media, stimulation of local governments to form information and consultation centers on issues of technical, financial and organizational support for the implementation thermal modernisation of buildings, formation of associations of co-owners of multi-apartment buildings, implementation of educational activities aimed at citizens of various ages and target groups, with the aim of fostering a conscious attitude and motivation to increase energy and resource efficiency, developing energy-saving habits.

Within the scope of Task 10 of the Ministry of Infrastructure, it provides for **the stimulation of local authorities** to carry out the certification of the energy efficiency of communally owned buildings, the implementation of complex thermal modernisation of such buildings and the provision of support for the construction (including the reconstruction of public communally owned buildings damaged as a result of military actions) in compliance with the requirements for nearly-zero energy buildings.

Another direction of the Concept is **ensuring the development of competences and qualifications** in the field of increasing the energy efficiency of buildings. Within the framework of this Task 11, provision of vocational education institutions with a modern material and technical base is envisaged; development and implementation of modern programs of training, retraining, advanced training in the

field of increasing the energy efficiency of buildings, design, energy management; implementation of competence development programs/trainings for employees of state authorities and local governments.

Task 12 of the Concept is important - **support of scientific, technical and innovative development** in the field of increasing the energy efficiency of buildings. It is planned to ensure the conduct of research and scientific and technical developments to determine and review the requirements for nearly-zero energy buildings; stimulation of subjects of scientific and technical and innovative activities for research and participation in international scientific and technical cooperation programs in the field of increasing the energy efficiency of buildings .

According to the calculations of the Ministry of Infrastructure, **the total approximate size of the need for financial resources** for the implementation of the Program is from UAH 172.91 billion to UAH 934.25 billion for the entire period of validity (until 2030), the majority of which is planned to be covered from extrabudgetary sources (including h. funds from foreign financial institutions, international financial organizations and technical support programs, etc.).

iii. Description of policy and measures to promote energy services in the public sector and measures to remove regulatory and non-regulatory barriers that impede the uptake of energy performance contracting and other energy efficiency service models

PM_EE_WEM_03 Energy service in the public sector

Goal: Attracting financing for the implementation of measures to improve the energy efficiency of state and communal property.

Legal basis: Law of Ukraine "On the introduction of new investment opportunities, guaranteeing the rights and legitimate interests of business entities for large-scale energy modernisation"; Law of Ukraine "On Public Procurement"; Budget Code of Ukraine; Law of Ukraine "On Energy Efficiency"; Resolution of the Cabinet of Ministers of Ukraine of October 12, 2022 No. 1178 "On approval of the specifics of public procurement of goods, works and services for customers, provided for by the Law of Ukraine "On Public Procurement", for the period of the legal regime of martial law in Ukraine and within 90 days from on the day of its termination or cancellation" (Official Gazette of Ukraine, 2022, No. 84, Article 5176) .

Time frames: 2015 - indefinitely.

Responsible bodies/organizations: Ministry of Infrastructure; SAE.

Description: In 2015, the principles of providing energy service for state and communal property (buildings, structures, their groups, objects and/or elements of the improvement object) were regulated. At the same time, amendments were made to the Budget Code of Ukraine, which allowed managers of budget funds to make long-term obligations for the energy service. The conclusion of energy service contracts is carried out according to public procurement procedures through the Prozorro system. The main criterion for the selection of a tender offer is the performance indicator of the energy service contract, which is defined as the total value of the discounted differences between the customer's annual cost reductions and the annual payments to the energy service provider over a twenty-year period. The Cabinet of Ministers of Ukraine approved the model energy service contract, which is a reference for budgetary institutions and investors²¹³ .

²¹³ <https://zakon.rada.gov.ua/laws/show/845-2015-p#Text>

The Law of Ukraine "On Energy Efficiency" expanded the subject of the energy service contract, including systems of engineering facilities united by a single technological cycle, or their separate energy-consuming equipment. This law also stipulates that state authorities and self-governments must evaluate the possibility of concluding an energy service contract in the case of purchasing services for the supply of electricity, natural gas, thermal energy, and hot water supply services. Such assessment will be carried out in accordance with the methodology that must be approved by the Ministry of Infrastructure.

In accordance with the Licensing conditions for the conduct of business activities in the field of heat supply, approved by the resolution of the NEURC of March 22, 2017 No. 308, economic entities carrying out business activities in the transportation of thermal energy must not take any measures that prevent the implementation of energy services and other energy-efficient measures that restrain the development of energy service markets and other energy-efficient measures, including by violating the deadlines for issuing technical conditions for connection (joining) to networks, abuse of a monopoly position, unfair competition, creating obstacles for business entities in the process of competition, achieving unfair advantages in competition in accordance with the law.

SAEE ensures the functioning of information bases of potential energy service facilities and energy service providers. However, open access to these information bases is temporarily blocked during the legal regime of martial law and until its end. As of the end of April 2024, 637 ESCO contracts were concluded in Ukraine for a total amount of UAH 2.07 billion.

In 2023, the project of the Global Environmental Fund (GEF) "Elimination of barriers to promote investments in the energy efficiency of public buildings in small and medium-sized cities of Ukraine through the use of the ESCO mechanism", implemented by the United Nations Development Program (UNDP), conducted a review of 53 energy service contracts that were concluded in 2019 in 10 partner cities. The contracts analysed were aimed at the modernisation of heating systems and the implementation of remote energy monitoring of buildings, one project - at the modernisation of the outdoor lighting network. Thanks to these projects, the partner cities received savings over four years 5.6 thousand Gcal of thermal energy and 6.5 million kWh of electrical energy. The average annual CO₂ reduction for 2019-2022 is 1,241 tons of CO₂/year²¹⁴.

According to UNDP²¹⁵, the market of energy efficiency improvement contracts in Ukraine is formed by 41 ESCOs, but five market players account for about 68 percent of the total value of the contracts.

Barriers to expanding the use of energy services are limited access to ESCO credit financing and the high cost of credit funds. Also, the barrier to expanding the use of the energy service is the limitation of the existing models of the functioning of the mechanism in Ukraine. Analysis of the application of energy service contracts in developed countries²¹⁶ makes it possible to identify the most common models:

- Energy service contract of guaranteed savings - GSC (Guaranteed Savings Contract);
- Energy service contract of shared savings - SSC (Shared Savings Contract);
- Energy service performance contract with a guaranteed return on investment - FOC (First Out Contract);
- Energy service contract for the supply of energy resources and energy management - (Chauffage Contract);
- Energy service contract for full management of real estate - (Full Management Contract).

²¹⁴

<https://www.undp.org/uk/ukraine/publications/ohlyad-naykrashchych-praktyk-dyzaynu-rynku-esko-ta-rekomendatsiyi-dlya-ukrayiny>

²¹⁵ <https://www.undp.org/sites/g/files/zskgke326/files/2023-05/ukrainian.pdf>

²¹⁶ <https://op.europa.eu/en/publication-detail/-/publication/cf22a232-4bc5-4108-a3f7-f9de31087728>

In Ukraine, only the GSC (Guaranteed Savings Contract) model of energy service contracts actually works, which is actually the simplest, requires the least effort to implement, but which is unable to provide a systematic and comprehensive approach to the implementation of energy-efficient measures. This is evidenced by the practice of energy service contracts in Ukraine, the most popular measures of which are the modernisation of heating stations, boiler houses, and the transfer of the energy service facility to other types of energy supply. At the same time, the practice of implementing complex projects that involve expensive measures to insulate enclosing structures in combination with equipping energy service facilities with modern systems using renewable energy sources, and the introduction of energy management systems are not common. Before the full-scale invasion of the Russian Federation into Ukraine, the average increase in the cost of equipment and materials for the customer as part of the implementation of the energy service contract was 250-300%.

After the full-scale invasion of the Russian Federation into Ukraine, there was a decrease in access to credit funds, an increase in the cost of equipment and materials, an increase in the risks of doing business in general, which significantly reduced the dynamics of concluding energy service contracts in Ukraine. Therefore, the energy service mechanism needed support from the state for further functioning.

To this end, in 2023 and 2024, the Cabinet of Ministers of Ukraine determined the specifics of public procurement of goods, works and services for the period of the legal regime of martial law in Ukraine and within 90 days from the date of its termination or cancellation²¹⁷, which provided for significant simplifications and easing the procedures for concluding energy service contracts for the period of the legal regime of martial law in Ukraine and within 90 days from the date of its termination or cancellation, namely:

- the procedure for determining the basic level of consumption of fuel and energy resources and housing and communal services has been simplified;
- the possibility of not publishing some information regarding purchases in the electronic procurement system has been introduced;
- the list of cases in which energy service purchases can be made by concluding an energy service contract without the use of open tenders has been expanded;
- the need for the customer of the energy service contract to submit the essential terms of the energy service contract to the State Energy Efficiency Agency (for state-owned objects), the Verkhovna Rada of the Autonomous Republic of Crimea, the relevant local council (for communally owned objects) is excluded;
- expanded the powers of managers of budget funds, in whose operational management or economic responsibility there are objects for which energy service procurement is carried out, in terms of the possibility for them to take long-term obligations for energy service without the approval of the State Energy Efficiency Agency (in relation to state-owned objects), the Verkhovna Rada of the Autonomous of the Republic of Crimea, the relevant local council (regarding communal property objects) of essential conditions of energy service contracts.

Currently, the effectiveness of the implementation of the provided mechanisms is being evaluated, since in addition to simplifying the working conditions of business entities on the market of energy service contracts, they contain risks related to the effectiveness of the implementation of the contracts themselves. Thus, the use of only data for two years or energy certificate data for the calculation of the base level carries risks of correctness of the definition of the base level and subsequent proper assessment of the savings achieved as a result of the implementation of such a contract.

At the same time, the rule regarding the possibility of concluding energy service contracts without the use of open tenders is only for energy service providers with experience in performing energy service contracts with a level of reduction in consumption and/or costs for payment of relevant fuel and energy resources and/or housing and communal services of at least 50 percent, may have a negative impact on competition in this area, since, as already indicated above, of the existing 41 ESCO companies, about 68 percent of the total value of contracts is accounted for by five market players.

²¹⁷ <https://zakon.rada.gov.ua/laws/show/1178-2022-п#Text>

Planned measures: In order to develop this tool, the policy of the Ministry of Infrastructure envisages the following measures:

- reimbursement of part of the interest on loans taken out by them for comprehensive thermal modernisation of state and communal buildings - I quarter of 2024;
- ensuring the liquidity of energy service contracts as an investment asset, in particular as part of the preparation for the implementation of the pension reform and the filling of pension funds with "green" investment assets, as well as the regulation of the possibility of entering into factoring contracts - the first quarter of 2024;
- implementation of short express courses and route maps on technical supervision in the field of construction for those responsible for public procurement of energy services and acceptance and transfer of works and services - III quarter of 2024;
- introducing changes to the legislation regarding the implementation of demonstration projects and the dissemination of experience in the use of energy service services in residential buildings and other forms of investment in the energy efficiency of residential buildings, primarily for low-income households - IV quarter 2025 ²¹⁸.

iv. Other planned policies, measures and programmes to achieve the indicative national energy efficiency contributions for 2030 as well as other objectives referred to in point 2.2 (for example measures to promote the exemplary role of public buildings and energy-efficient public procurement, measures to promote energy audits and energy management systems, consumer information and training measures, and other measures to promote energy efficiency)

PM_EE_WEM_04 Minimum energy performance requirements for buildings

Goal: Establishing the maximum permissible energy consumption per unit of area or volume in new and existing buildings.

Legal basis: Law of Ukraine "On Energy Efficiency of Buildings"; order of the Ministry of Regions of July 11, 2018 No. 170 "On approval of the Methodology for determining the economically feasible level of energy efficiency of buildings" registered in the Ministry of Justice of July 16, 2018 under No. 822/32274; Order of the Ministry of Regions of October 27, 2020 No. 260 "On Approval of Minimum Requirements for the Energy Efficiency of Buildings" registered in the Ministry of Justice of July 16, 2018 under No. 825/32277.

Time frame: 2021. - indefinitely.

Responsible bodies/organizations: Ministry of Infrastructure.

Description: Minimum energy performance requirements for buildings are calculated on the basis of an economically feasible level and are reviewed at least every 5 years. The limit values for specific energy consumption for heating and cooling of residential buildings should range from 65 to 120 kWh/m², depending on the number of floors and the temperature zone. For reconstruction or major repairs, a correction factor of 1.2 is applied to these values. The current minimum requirements were adopted in 2020 and came into effect in January 2021.

According to the Long-term strategy for the thermal modernisation of buildings by 2030, at least 36 percent of residential buildings must meet the minimum requirements for energy efficiency of buildings by 2030; this share should increase to 71% in 2040.

²¹⁸ Operational plan of measures for the implementation in 2024–2026 of the Long-term strategy of thermal modernisation of buildings for the period until 2050, approved by the order of the Cabinet of Ministers of Ukraine of December 29, 2023 No. 1228-p (Official Gazette of Ukraine, 2024, No. 13, Article 843) : <https://zakon.rada.gov.ua/laws/show/1228-2023-%D1%80#Text>

Planned measures: As part of the practical implementation of the "Build Back Better" principle, the Government will revise the minimum energy performance requirements for buildings. The Ministry of Infrastructure will approve the updated minimum energy performance requirements for buildings in the IV quarter of 2025.²¹⁹

PM_EE_WAM_03 Nearly-zero energy buildings

Goal: Stimulation for the construction and thermal modernisation of buildings with the highest level of energy efficiency.

Legal basis: Law of Ukraine "On Energy Efficiency of Buildings"; Order of the Cabinet of Ministers of Ukraine of January 29, 2020 No. 88 "On approval of the Concept of implementation of state policy in the field of ensuring the energy efficiency of buildings in terms of increasing the number of nearly-zero energy buildings and approving the National Plan for increasing the number of nearly-zero energy buildings" (Official Gazette of Ukraine, 2020, No. 14, Article 580).

Time frame: 2025 - indefinitely.

Responsible bodies/organizations: Ministry of Infrastructure.

Description: In compliance with the requirements of Directive 2010/31/EU and the Law of Ukraine "On the Energy Efficiency of Buildings" in 2020, the Concept of State Policy Implementation in the Area of Energy Efficiency of Buildings was adopted in 2020 in terms of increasing the number of nearly-zero energy buildings (hereinafter - NZEB concept) and the National Plan to increase the number of nearly-zero energy buildings.

According to the NZEB Concept, it is planned that no later than December 31, 2027, the energy efficiency class of all buildings that are put into operation should not be lower than the requirements for energy-independent buildings in force on the date of the start of construction work, and no later than December 31, 2025, the energy effectiveness of state and communal buildings that are put into operation must not be lower than the requirements for energy-independent buildings in force on the date of the start of construction work. The concept also defines the maximum indicators of specific consumption of primary energy for energy-independent buildings (new construction):

- from 46 to 92 kWh/m² for residential buildings (depending on the number of floors and temperature zone);
- from 21 to 33 kWh/m³ for public buildings (depending on the number of floors and temperature zone);
- from 33 to 35 kWh/m³ for buildings and structures of educational institutions, health care institutions (depending on the temperature zone).

The long-term strategy for thermal modernisation of buildings envisages that at least 10% of public buildings will meet the requirements of nearly-zero energy buildings in 2030, and in 2040 it is expected that at least 25% of residential buildings will also meet such requirements.

In order to establish the obligation to comply with the requirements for buildings with a near-zero level of energy consumption, it is necessary to approve the relevant characteristics of such buildings in the state building regulations, and not only in the program document of public policy. The requirements for nearly-zero energy buildings and the procedure for monitoring the number of such buildings will be approved in the IV quarter of 2024.

²¹⁹ Operational plan of measures for the implementation in 2024–2026 of the Long-term strategy of thermal modernisation of buildings for the period until 2050, approved by the order of the Cabinet of Ministers of Ukraine of December 29, 2023 No. 1228-r (Official Gazette of Ukraine, 2024, No. 13, Article 843) : <https://zakon.rada.gov.ua/laws/show/1228-2023-%D1%80#Text>

For the IV quarter of 2025, it is planned to monitor compliance with the requirements for buildings with a near-zero level of energy consumption and define the categories of public buildings, as well as the implementation of legal regulations, ensuring the actual compliance with such requirements.²²⁰

PM_EE_WEM_05 Certification of energy efficiency of buildings

Goal: Assessment of compliance of the energy characteristics of the building and its elements with the established minimum requirements for the energy efficiency of buildings.

Legal basis: Law of Ukraine "On Energy Efficiency of Buildings"; order of the Ministry of Regions of July 11, 2018 No. 169 "On approval of the Methodology for determining the energy efficiency of buildings", registered in the Ministry of Justice of July 16, 2018 under No. 822/32274; order of the Ministry of Regina of July 11, 2018 No. 172 "On approval of the Procedure for conducting energy efficiency certification and the form of an energy certificate", registered in the Ministry of Justice of July 16, 2018 under No. 825/32277.

Time frames: 2018 - indefinitely.

Responsible bodies/organizations: Ministry of Infrastructure, SAEE.

Description: Certification of energy efficiency of buildings was implemented in accordance with the Law of Ukraine "On Energy Efficiency of Buildings" in 2018.

According to current Ukrainian legislation, energy efficiency certification is a type of energy audit of buildings that can be conducted by a certified energy auditor. Professional certification is carried out in accordance with the Procedure for certification of persons who intend to carry out activities related to energy efficiency certification, energy audit of buildings and inspection of technical installations, approved by Resolution No. 40 of the Cabinet of Ministers of Ukraine of January 16, 2024 (Official Gazette of Ukraine, 2024, No. 15, Article 954).

Mandatory certification is subject to:

- construction objects;
- buildings in which they intend to carry out thermal modernisation and/or insulation, for the implementation of which state support is provided;
- state-owned buildings that house executive authorities occupying more than 250 square meters of heated space;
- buildings of communal property, in which local self-government bodies are located, occupying more than 250 square meters of heated area;
- buildings of communal property with a heated area of more than 250 square meters, which are often visited by citizens.

Information about the issued energy certificates of buildings is publicly available on the Portal of the Unified State Electronic System in the field of construction. The same portal contains information about certified specialists in the audit of energy efficiency of buildings and specialists in the examination of engineering systems.

Placement of energy certificates in announcements about the sale or lease of the building is mandatory, provided that such a certificate is available. Thus, the requirement applies to new or retrofitted buildings. The single state electronic system in the field of construction contains 19,318 valid building energy certificates.²²¹

²²⁰ Operational plan of measures for the implementation in 2024–2026 of the Long-term strategy for thermal modernisation of buildings for the period until 2050, approved by the order of the Cabinet of Ministers of Ukraine of December 29, 2023 No. 1228 (Official Gazette of Ukraine, 2024, No. 13, Article 843): <https://zakon.rada.gov.ua/laws/show/1228-2023-%D1%80#Text>

²²¹ As of 04/04/2024 Register of energy certificates: https://e-construction.gov.ua/document/optype=13/filter=337_1

PM_EE_WEM_06 Exemplary role of buildings of state authorities

Goal: Demonstration of the benefits of implementing energy-efficient measures, increasing the demand for energy-efficient materials and technologies, and increasing the number of jobs.

Legal basis: Law of Ukraine "On Energy Efficiency of Buildings"; Concept of DCP supporting thermal modernisation of buildings until 2030.

Time frame: 2021 - indefinitely.

Responsible bodies/organizations: Ministry of Infrastructure, SAEE.

Description: The requirements of Article 5 of Directive 2012/27/EU are transposed by the Law of Ukraine "On Energy Efficiency of Buildings". In accordance with this Law, the Cabinet of Ministers of Ukraine establishes a target indicator of energy saving in the buildings of state authorities, which is revised every five years. The requirement to achieve the target indicator of energy saving in the buildings of state authorities applies to buildings that meet all the following characteristics:

- are in state or communal property;
- in which the apparatus of the central executive authority is located;
- the heated area exceeds 250 square meters.

In order to ensure the exemplary role of buildings of state authorities, the Concept of the program to support thermal modernisation of buildings (PM_EE_WAM_02) provides for the following measures:

- certification of the energy efficiency of state and communal buildings, which house the central bodies of executive power, other bodies of state power, their territorial bodies, local state (military) administrations;
- production of technical passports (carrying out a technical inventory) of state and communal buildings in which the central bodies of executive power, other bodies of state power, their territorial bodies, local state (military) administrations are located;
- implementation of priority energy-efficient measures or implementation of thermal modernisation projects of buildings (including with the use of renewable energy sources)
- ensuring the construction (including the reconstruction of damaged as a result of military actions) of public buildings of state ownership, in which state authorities are located, in compliance with the requirements for nearly-zero energy buildings.

PM_EE_WEM_07 National database of energy and operational characteristics of buildings

Goal: Monitoring the energy and operational characteristics of buildings, monitoring the achievement of the energy saving target in the buildings of state authorities, providing state authorities, local government with data on the volumes of energy consumption and utility services.

Legal basis: Law of Ukraine "On Energy Efficiency of Buildings".

Time frame: 2024 - indefinitely.

Responsible bodies/organizations : Ministry of Infrastructure; SAEE; local self-governments.

Description: Since 2017, a database of energy certificates has been introduced in Ukraine, which accumulates and contains information on energy efficiency classes and energy indicators of buildings that have passed the energy efficiency certification procedure. However, these data are based on calculation methods for assessing the energy performance of buildings and cover a relatively small share of existing buildings in Ukraine. In order to create a source of data on the state of the national fund of buildings, their energy and operational characteristics, by the Law of Ukraine

"On Amendments to Some Laws of Ukraine Regarding the Creation of Conditions for the Introduction of Complex Thermal Modernisation of Buildings" established the creation of the National Database of Energy and Operational Characteristics of Buildings in Ukraine.

During 2022-2024, work was carried out on the development of technical documentation and regulatory legal acts regarding the procedure for maintaining and filling the database. Currently, the Ministry of Infrastructure has developed all the necessary documents and has attracted the necessary funds for the development of the database. As of May 2024, work on the development of the database as part of the EDESSB has begun, which is scheduled to be completed in the first half of 2024.

The procedure for maintaining a database of energy and operational characteristics of buildings, developed by the Ministry of Infrastructure, is planned for submission to the Cabinet of Ministers of Ukraine in the first half of 2024.

In 2024, it is expected that the database will begin to be filled with information about buildings of state authorities, enterprises, institutions and organizations belonging to the sphere of administration of state authorities, local governments, district, oblast, Kyiv city state (military) administrations, public buildings of territorial communities belonging to to communal property of rural, settlement, urban territorial communities, apartment buildings. The subjects of entering information into the database of energy and operational characteristics of buildings will be state authorities, enterprises, institutions and organizations belonging to the sphere of administration of state authorities and local government.

Taking into account the expected volumes of the number of buildings and the list of indicators that should be entered into the database, it is expected that the period of initial filling of the database with the list and information about buildings will last during 2025-2026.

PM_EE_WEM_08 Energy management in state authorities

Goal: Planning, implementation and monitoring of the results of the implementation of energy-efficient measures, reducing the financial burden on the budget.

Legal basis: Law of Ukraine "On Energy Efficiency"; Law of Ukraine "On Energy Efficiency of Buildings"; Resolution of the Cabinet of Ministers of Ukraine of December 23, 2021 No. 1460 "On the Implementation of Energy Management Systems" (Official Gazette of Ukraine, 2022,

No. 16, Art. 846).

Time frame: 2021 - indefinitely.

Responsible bodies/organizations: Ministry of Infrastructure, SAEE.

Description: The Law of Ukraine "On Energy Efficiency" obliged state authorities, enterprises, institutions and organizations belonging to the sphere of their management to implement management systems that will determine energy policy, goals, energy tasks, and action plans for achieving goals. Energy management systems in state authorities do not require certification and are implemented in accordance with the Procedure for introducing and ensuring the functioning of energy management systems of state authorities, enterprises, institutions and organizations belonging to the sphere of their management, approved by the resolution of the Cabinet of Ministers of Ukraine of December 23, 2021. No. 1460 (Official Gazette of Ukraine 2022, No. 16, Article 846). The State Energy Efficiency Agency monitors the implementation of energy management systems and reports to the Government twice a year on the progress achieved.

As of the end of 2023, 55 state authorities and 21 regional state (military) administrations have started work on implementing the energy management system. Energy monitoring covers more than 7,000 buildings of state authorities.

In order to simplify the implementation of energy management systems in state authorities, the State Energy Efficiency Agency developed and published a sample (template) of the order "On the implementation of the energy management system" ²²² and a sample (template) of the plan for the implementation and operation of the energy management system ²²³.

The State Energy Efficiency Agency is also active in raising awareness of approaches to the implementation of energy management systems: in 2022-2023, a series of online training seminars was held in which more than 3,500 students participated.

PM_EE_WEM_09 Energy management in local self-governments

Goal: Planning, implementation and monitoring of the results of the implementation of energy-efficient measures, rational use of budget funds.

Legal basis: Law of Ukraine "On Energy Efficiency"; Law of Ukraine "On Energy Efficiency of Buildings"; Resolution of the Cabinet of Ministers of Ukraine of December 23, 2021 No. 1460 "On the Implementation of Energy Management Systems" (Official Gazette of Ukraine, 2022,

No. 16, Art. 846).

Time frame: 2021 - indefinitely

Responsible bodies/organizations: Ministry of Infrastructure, SAEE.

Description: The Law of Ukraine "On Energy Efficiency" provides for the implementation of energy management systems of local government organizations on a voluntary basis, by decision of the relevant council. At the same time, a mandatory condition for obtaining state support (aid) for self-governing municipalities for the implementation of energy-efficient measures is the presence of a decision on the introduction of an energy management system in such bodies.

The Government recommends that LGUs be guided during the implementation of energy management systems by the Procedure for implementing and ensuring the functioning of energy management systems of state authorities, enterprises, institutions and organizations belonging to the sphere of their management. ²²⁴

The powers of the State Energy Efficiency Agency include the monitoring of the state of implementation of the energy management systems of the local government, which must be carried out in accordance with the procedure determined by the Ministry of Infrastructure.

As of 2021, energy management or energy monitoring systems have been implemented in 225 local authorities, and such systems are being developed in another 113.

PM_EE_WEM_10 Local energy plans

Goal: Analysis of the state of energy and other infrastructure, the potential for implementing energy-efficient measures and increasing the share of renewable energy use, rational use of budget funds, identification of priority projects for investment attraction.

Legal basis: Law of Ukraine "On Energy Efficiency"; order of the Ministry of Infrastructure of December 21, 2023 No. 1163 "On approval of the Methodology for the development of local energy plans", registered in the Ministry of Justice on February 16, 2024 under No. 245/41590.

Time frames: 2022-2030

Responsible bodies/organizations: Ministry of Infrastructure; SAEE.

²²² https://saee.gov.ua/sites/default/files/blocks/Energy_management_order_EXAMPLE_2023_0.pdf

²²³ https://saee.gov.ua/sites/default/files/blocks/Energy_management_plan_EXAMPLE_2023_0.pdf

²²⁴ <https://zakon.rada.gov.ua/laws/show/1460-2021-%D0%BF#n664>

Description: The Law of Ukraine "On Energy Efficiency" laid the foundations for the mandatory implementation of a local energy plan. In accordance with this Law of Ukraine, LGUs must develop local energy plans by November 14, 2024. The Ministry of Infrastructure has approved the Procedure for developing and updating local energy plans, which should determine the composition, content and approach to the preparation of such plans.

The Ministry of Infrastructure together with the U-LEAD (Ukraine – Local Empowerment, Accountability and Development) program piloted the development of local energy plans in accordance with the approaches defined by the Methodology project. Another 10 LGUs are assisted in the development of local energy plans by the analytical center DiXi Group with the support of the Dutch government program MATRA and the European Climate Foundation. The EU STARTER Project also supports LGUs in the preparation of local energy plans, within the framework of which it is planned to prepare 6 plans. However, not all LGUs can be covered by such support. It is necessary to take measures to strengthen the capacity of local governments to develop and update local energy plans and to implement energy-efficient measures on the part of the state.

Obtaining information by local authorities from electricity suppliers and natural gas suppliers about the amount of energy supplied by them and information about the energy consumed by consumers located within the territory of the relevant administrative-territorial unit remains a problematic issue. The obligation to provide such information is enshrined in the Law of Ukraine "On Energy Efficiency", at the same time, the experience of local authorities shows the need for additional regulation of this issue. One of the alternatives for solving the policy problem is to establish a similar requirement in the Licensing conditions for conducting economic activities for the supply of electricity to the consumer and the Licensing conditions for conducting economic activities for the supply of natural gas.

The issue of correlation of local energy plans with action plans for sustainable energy development and climate, which were adopted by the 102 local government signatories of the Agreement of Mayors, also requires additional clarifications and recommendations from the Ministry of Infrastructure and the State Energy Efficiency Agency.

According to the study of the practice of application and effectiveness of the Law of Ukraine "On Energy Efficiency" of the Westminster Foundation for Democracy as of January 2023, among the 371 local government organizations surveyed, 198 implemented energy planning or developed plans for the implementation of energy efficiency measures ²²⁵.

PM_EE_WEM_11 Regional offices for decarbonisation and energy efficiency and

Goal: Strengthening cooperation between central and local state authorities in the issue of implementing energy-efficient measures.

Legal basis : the Law of Ukraine "On Local Self-Government in Ukraine" (establishment of offices is not an obligation, but it is possible according to the powers of the local government).

Time frame : 2023 - indefinitely.

Responsible bodies/organizations : SAEE.

Description: It is assumed that the SAEE and local state authorities will cooperate in the following main areas:

- energy consumption management: implementation of energy management systems, development of a local energy plan, energy certification of buildings, energy audits;
- determination and use of the potential of replacing traditional types of fuel, alternative heat supply, highly efficient cogeneration, production of biogas and biomethane;

²²⁵ https://drive.google.com/file/d/1zog_bVhIbHofAolvaScYM1eIV56S1hKa/view

- attraction of financial resources for energy-efficient transformation of regions (energy service, municipal green finance, international financial assistance, etc.);
- education and popularization in the direction of energy efficiency.

As of March 2024, five regional offices were opened, the first office was opened on November 7, 2023.

PM_EE_WEM_12 Energy-efficient procurement

Goal: Effective use of public funds, increasing demand for energy-efficient materials and technologies.

Legal basis: Law of Ukraine "On Energy Efficiency"; Law of Ukraine "On Public Procurement".

Time frames: 2024 - indefinitely.

Responsible bodies/organizations: Ministry of Economy; Ministry of Infrastructure.

Description: In 2020, amendments were made to the Law of Ukraine "On Public Procurement", which allowed the use of life cycle cost as a criterion for evaluating tender offers. The cost of the life cycle is the sum of the cost of the item of purchase or its part (lot) and other costs that will be borne directly by the customer during the use, maintenance and termination of use of the item of purchase. Currently, the Ministry of Economy is implementing a project to spread the use of the life cycle costing method in public procurement.

In addition, the Law of Ukraine "On Energy Efficiency" defines the legal basis for implementing energy-efficient procurement. When carrying out public procurement of energy-consuming goods, the energy efficiency class of such goods must not be lower than the energy efficiency class determined by the Cabinet of Ministers of Ukraine, taking into account normative legal acts in the field of energy labeling, or the energy efficiency indicators of such products (goods) must correspond to the indicative indicators determined regulations in the field of eco-design, or such products (goods) must meet the standards in the field of environmental labeling type I. This requirement applies to all customers within the meaning of the Law of Ukraine "On Public Procurement". As of February 2024, the permissible energy efficiency classes for energy-consuming goods have not been determined.

In the IV quarter of 2024, the Ministry of Infrastructure plans to approve sample technical specifications for purchasing energy-consuming products. In addition, it is planned that the Ministry of Economy will develop advisory and informational materials on the financial and economic advantages of purchasing highly energy-efficient products (goods) in case of sub-threshold purchases of energy-consuming products (goods) ²²⁶. Thus, energy-efficient procurement will be implemented by the end of 2024.

PM_EE_WEM_13 Energy labeling and ecodesign

Goal: Reduction of final energy consumption

Legal basis: Law of Ukraine "On Energy Efficiency"; Law of Ukraine "On State Market Supervision and Control of Non-Food Products"; order of the Ministry of Energy of April 27, 2022 No. 164 "On the approval of the Technical Regulations for energy labeling of energy-consuming products", resolution of the Cabinet of Ministers of Ukraine of October 3, 2018 No. 804 "On the approval of the Technical Regulations on the establishment of a system for determining

²²⁶ Operational plan of measures for the implementation in 2024–2026 of the Long-term strategy of thermal modernisation of buildings for the period until 2050, approved by the order of the Cabinet of Ministers of Ukraine of December 29, 2023 No. 1228: <https://zakon.rada.gov.ua/laws/show/1228-2023-%D1%80#Text>

requirements for eco-design of energy-consuming products" (Official Gazette of Ukraine, 2018, No. 80, Article 2678).

Time frames: 2015 - indefinitely.

Responsible bodies/organizations: Ministry of Infrastructure; Ministry of Economy; SAEE; State Service on Food Safety and Consumer Protection.

Description: In order to fulfill Ukraine's obligations under the Association Agreement between Ukraine and the European Union and the Treaty on the Establishment of the Energy Community, Ukraine is implementing a system of energy labeling and establishing requirements for the eco-design of energy-consuming products in accordance with EU legislation. In Ukraine, there are 2 framework technical regulations, 25 technical regulations establishing requirements for eco-design of certain groups of energy-consuming goods, and 15 technical regulations on energy labeling.

Market supervision of compliance with eco-design and energy labeling requirements is carried out by the State Production and Consumer Service.

Results: During 2021, 118 checks of the characteristics of energy-consuming goods were carried out. According to the results of the inspections, 131 restrictive (corrective) measures were adopted, namely:

- 130 decisions on limiting the provision of goods on the market;
- 1 decision prohibiting the supply of goods on the market.

Also, checks of the characteristics of energy-consuming goods were carried out with the selection of samples for examination (testing), in particular, these were lamps, light bulbs, LED lamps. Of the 68 samples selected, 35 samples did not meet the established requirements.

In connection with the introduction of martial law, the resolution of the Cabinet of Ministers of Ukraine of March 13, 2022 No. 303 "On the termination of measures of state supervision (control) and state market supervision under martial law" (Official Gazette of Ukraine, 2022 p., no. 25, Article 1355).

PM_EE_WEM_14 Experimental project on creating favorable conditions for ensuring efficient consumption of electricity in Ukraine

Goal: Reduction of final energy consumption, reduction of load on the power system, behavioral changes.

Legal basis: Resolution of the Cabinet of Ministers of Ukraine of January 10, 2023 No. 25 "On the implementation of an experimental project to create favorable conditions for ensuring efficient consumption of electricity in Ukraine" (Official Gazette of Ukraine, 2023, No. 7, Article 584).

Time frames: 2023-2024

Responsible bodies/organizations: Ministry of Economy.

Description: The Ministry of Economy is implementing an experimental project within the framework of which it is planned to replace 50 million incandescent lamps with new LED lamps. Citizens of Ukraine who have reached the age of 18 and certain categories of legal entities have the right to participate in the project: institutions of health care, education, culture, social protection of the population (municipal and state ownership), physical culture and sports institutions (municipal property), managers of apartment buildings, association of co-owners of an apartment building. Individuals can receive up to five energy-efficient lamps, legal entities - 2 or 3 lamps for every 10 m², depending on the type of premises. Lamps are transferred through the branch of JSC "Ukrposhta".

The project is supported by the EU, which financed the purchase of 35 million LED lamps, and France, which additionally financed the purchase of another 5 million lamps.

Based on the results of the implementation of the experimental project, an approach to the gradual withdrawal of incandescent lamps from the Ukrainian market will be determined.

As of October 11, 2023, 21.56 million LED lamps were issued, of which: 20.29 million - to individuals; 1.27 million - to legal entities (including condominiums - 274,619 units). 16.39 million incandescent lamps were disposed of. The estimated achieved energy saving is 1.17 GW*h.

PM_EE_WEM_15 Energy audit of large enterprises

Goal: Analysis of energy consumption profile and identification of optimal energy efficiency measures

Legal basis: Law of Ukraine "On Energy Efficiency"; Resolution of the Cabinet of Ministers of Ukraine of December 1, 2023 No. 1258 "On approval of the Procedure for Conducting and Requirements for Energy Audit of Processes and Transport" (Official Gazette of Ukraine, 2024, No. 4, Article 155).

Time frame: 2021 - indefinitely.

Responsible bodies/organizations: Ministry of Infrastructure.

Description: The Law of Ukraine "On Energy Efficiency" introduced mandatory energy audits by large enterprises every four years. As of 2022 this requirement applied to 494 enterprises. The first energy audits must be conducted by November 14, 2024. In December 2023, the Procedure for Conducting and Requirements for Energy Audits of Processes and Transport was adopted, which regulates the procedures for preparing, conducting and registering the results of energy audits of processes and transport, as well as minimum requirements for the form and content of the report and an extract from the energy audit report. Energy audits must be conducted taking into account national standards harmonized with European standards: DSTU EN 16247-3:2015 "Energy audits. Part 3. Processes (EN 16247-3:2014, IDT)" and DSTU EN 16247-4:2015 "Energy audits. Part 4. Transport (EN 16247-4:2014, IDT)". The goals and limits of energy audits are determined by the customer. In the future, this may lead to a situation where mandatory energy audits of enterprises operating in the same industry will be incomparable.

Mandatory energy audits can be conducted by energy auditors who have passed confirmation of qualifications in the areas of buildings, processes or transport. The procedure for confirming the qualifications of persons who intend to carry out energy audit activities and qualification requirements for energy auditors must be approved by the Cabinet of Ministers of Ukraine. As of the beginning of February 2024, such normative legal acts have not been adopted. Thus, the subjects of large enterprises do not have the opportunity to fulfill the requirements of the Law of Ukraine "On Energy Efficiency".

Alternatively, large business entities have the right to implement energy and/or environmental management systems. Such systems must be certified to ISO 50001 and/or ISO14001.

In the framework of public consultations on NECP, the participants noted that the state establishes requirements for conducting mandatory energy audits, but does not provide the opportunity to implement energy-efficient measures. The main barrier to increasing the energy efficiency of enterprises is the complexity and high cost of attracting financing. As of 2024, it can be stated that there is no systemic support from the state for the implementation of energy-efficient measures by enterprises. There are separate programs of donors and international financial organizations (IFIs) in Ukraine to support such activities: UNIDO Credit Guarantee Fund ²²⁷, KfW "Add Energy to Your Business" Program ²²⁸, Finnish-Ukrainian Trust Fund (program completed) ²²⁹. The results of these programs can be used as an analytical basis for the design of state support programs.

²²⁷ <http://www.ukriee.org.ua/uk/proekt/komponenti/komponent-3-finansoviy-mekhanizm/>

²²⁸ <https://bdf.gov.ua/programs/prohrama-doday-enerhiyi-tvoyemu-biznesu/>

²²⁹ <https://saee.gov.ua/uk/content/finland-ukraine-trust-fund>

The project of the Strategy for recovery, sustainable development and digital transformation of small and medium-sized enterprises for the period until 2027²³⁰, developed by the Ministry of Economy, provides for the introduction of a program of vouchers for conducting professional energy audits and subsidies for improving energy efficiency for micro and small businesses. In particular, energy audits are expected to be carried out at some enterprises in such sectors as agriculture, forestry, fisheries, mining and quarrying, processing industry, supply of electricity, natural gas, water supply and drainage, waste management and construction. ESU, among the measures in the "Energy efficiency" direction, envisages the launch of a state program of financial support for improving energy efficiency for small and medium-sized enterprises.

In addition, the state Decarbonization and Energy-Efficient Transformation Fund (PM_EE_WEM_02) can potentially support energy-efficient measures for enterprises.

v. Where applicable, a description of policies and measures to promote the role of local renewable energy communities in contributing to the implementation of policies and measures in points i, ii, iii and iv

Currently, the provisions of Directive (EC) 2018/2001 regarding the activity and stimulation of RES communities have not been fully transposed into Ukrainian legislation. The Law of Ukraine "On Alternative Energy Sources" regulates tools for stimulating one of the types of renewable energy communities - energy cooperatives. Energy cooperatives have the opportunity to receive a "green" tariff for the produced electricity or to receive incentives based on the mechanism of self-production (net-billing).

NEURC developed a draft of the Law of Ukraine "On Amending Some Laws of Ukraine Regarding the Transposition of Acts of the Energy Community", which, among other things, regulates the activities of energy consumer associations (RES-communities). The provisions of this draft law of Ukraine are aimed at the transposition of the requirements of Directive (EU) 2019/944. This draft Law of Ukraine provides for the provision of energy efficiency services by energy consumer associations. At the same time, it is not detailed what exactly these services are, as well as the rights and obligations of energy consumer associations arising in connection with the provision of such services.

In addition to finalizing the legislation to expand the role of RES-communities, it is also necessary to carry out measures to increase the level of awareness among the population and representatives of local governments about the benefits of creating energy cooperatives. Such activities can be carried out by the regional offices of decarbonisation and energy efficiency, as well as the State Energy Efficiency Office.

vi. Description of measures to develop measures to utilise energy efficiency potentials of gas and electricity infrastructure

PM_EE_WAM_04 Assessment of the energy efficiency potential of the gas transportation system, electricity transmission system, gas distribution systems, electricity distribution systems

Goal: increasing the efficiency of energy networks, stimulating investments in energy-efficient measures.

Legal basis: Law of Ukraine "On Energy Efficiency"

Time frame: 2021 - indefinitely.

Responsible bodies/organizations: Ministry of Energy; NEURC; SAEE.

²³⁰ <https://www.me.gov.ua/Documents/Detail?lang=uk-UA&id=454b13bc-3503-4185-b59db60f6467748c&title=ProektStrategiiVidnovlenniaStalogoRozvitkuTaTsifrovoiTransformatsiiMalogoTaSerednogoPidprymitstvaNaPeriodDo2027-Roku>

Description: The operator of the transmission system and operators of electricity distribution systems, the operator of the gas transmission system and the operators of gas distribution systems must evaluate the energy efficiency potential of the respective systems every 5 years in accordance with the Law of Ukraine "On Energy Efficiency". Such assessment should be carried out in accordance with the Methodology approved by the Ministry of Energy. As of February 2024, the Methodology is at the development stage.

At the same time, operators of transmission, transportation and distribution systems are subject to mandatory energy audits (more details: PM_EE_WEM_15 Energy audit of large enterprises). The results of such audits will be taken into account when assessing the energy efficiency potential. The requirement to carry out an energy audit is included in the license conditions for carrying out economic activity on the transmission of electricity; production of electrical energy; supply of electrical energy to the consumer; distribution of electrical energy;²³¹ licensing conditions for conducting economic activity for the production of thermal energy; transportation of heat energy by trunk and local (distribution) heat networks, and supply of heat energy.²³²

In accordance with the resolution of the NEURC of January 30, 2024 No. 222 "On the approval of the Amendments to the Procedure for Controlling Compliance by Licensees Conducting Activities in the Energy and Utilities Sectors with Legislation in the Relevant Areas and License Terms"²³³ The regulator may impose fines on licensees in the amounts, provided, in particular, by the Law of Ukraine "About energy efficiency"²³⁴. However, the amount of fines for failure to conduct mandatory energy audits in accordance with this Law of Ukraine as of February 2024 has not been established.

PM_EE_WEM_16 Intelligent energy accounting systems

Goal: promoting the active participation of consumers in regulating their consumption (demand management), as well as other participants in the electricity market in the provision of balancing and auxiliary services, obtaining accurate information for the formation of bills based on actual energy consumption and actual time of consumption.

Legal basis: the Law of Ukraine "On Energy Efficiency", the Code of Commercial Accounting of electricity, approved by Resolution No. 311 of NEURC of March 14, 2018.

Time frames: 2018 - indefinitely.

Responsible bodies/organizations: Ministry of Energy, NEURC.

Description: In accordance with the Law of Ukraine "On Energy Efficiency", the operator of the transmission system and operators of electricity distribution systems, the operator of the gas transmission system and the operators of gas distribution systems, based on an assessment of the technical feasibility and economic feasibility of installing intelligent accounting systems, take measures to install intelligent accounting systems.

The issue of installing smart meters and automated systems of commercial electricity accounting (ASCOE) is regulated by the Code of Commercial electricity Accounting. Administrators of commercial accounting must provide the NEURC with the results of an economic analysis of all long-term profits and costs for market participants from the introduction of smart meters and ASKOE, functional requirements for such equipment, and proposals for an economically justified and cost-effective method of introducing intelligent meters and ASKOE and the terms during which this is automated accounting can be implemented.

²³¹ <https://www.nerc.gov.ua/acts/pro-zatverdzhennya-zmin-do-deyakih-licenzijnih-umov>

²³² <https://zakon.rada.gov.ua/laws/show/v0308874-17#Text>

²³³

<https://www.nerc.gov.ua/acts/pro-zatverdzhennya-zmin-do-poryadku-kontrolyu-za-dotrimannyam-licenzijatami-shcho->

[provadyat-diyalnist-u-sferah-energetiki-ta-komunalnih-poslug-zakonodavstva-u-vidpovidnih-sferah-ta-licenzijn-7](https://www.nerc.gov.ua/storage/app/uploads/public/647/a27/0a6/647a270a68097079576461.pdf)

²³⁴ <https://www.nerc.gov.ua/storage/app/uploads/public/647/a27/0a6/647a270a68097079576461.pdf>

Commercial accounting platforms containing:

- electrical installations with a connected capacity of 150 kW or more or an average monthly electricity consumption of more than 50,000 kWh at consumer facilities (except multi-apartment residential buildings and household consumers);
- generating plants and/or electrical energy storage plants with the possibility of releasing electrical energy into electrical networks;
- electrical installations of the consumer at his initiative.

The issue of intelligent natural gas accounting systems is described in policy PM_IMG_WAM_15 Analysis of benefits and costs of telemetry.

As of the end of 2022, 2.2 million smart meters with remote reading and management were installed at household consumers. Another 464,000 such meters were planned to be installed in 2023. The average level of equipment of household consumers with smart meters is 12.4% ²³⁵. There are no data on non-household consumers.

PM_EE_WEM_17 Regulation of the combined production of heat and electricity (cogeneration)

Purpose : creation of legal frameworks for increasing the efficiency of fuel use in energy production processes or other technological processes, development and application of cogeneration technologies.

Legal basis : Law of Ukraine "On the combined production of heat and electricity (cogeneration) and the use of waste energy potential".

Time frames : 2005 - indefinitely.

Responsible bodies/organizations : Ministry of Infrastructure, NEURC, Ministry of Energy.

Description: State policy in the field of use of cogeneration plants is based on the following principles:

- promoting the reconstruction of existing heat-generating facilities into installations for the combined production of electric and thermal energy;
- the creation of distributed (local) power generation capacities as a condition for increasing the reliability and security of energy supply at the regional level;
- economic stimulation of the use of cogeneration plants at enterprises regardless of the form of ownership and branch affiliation.

As instruments for stimulating cogeneration, the Law of Ukraine "On the combined production of heat and electricity (cogeneration) and the use of waste energy potential" defines the granting to the owners (users) of cogeneration plants of the right to unhindered access to local (local) electrical networks and the sale of produced electrical energy to individual consumers under contracts, including the right to supply the consumer with electricity during the hours of the day of the highest or average load of the electric network (peak and semi-peak periods of the day) simultaneously (in addition) with the main supplier of electricity.

The Law of Ukraine "On Heat Supply" includes among the areas of development of heat supply systems the implementation of cogeneration plants, including those based on existing heating boiler houses.

²³⁵ <https://map.ua-energy.org/uk/resources/b676f89a-188b-4179-8d56-1b984a2e477f/>

In 2023-2024, a number of legislative changes aimed at increasing the number of cogeneration plants were developed:

- a simplified procedure for connecting individual energy consumers to the networks of electricity producers at cogeneration plants (CHP) with a capacity of up to 20 MW is provided. Such producers have the right to supply electricity to their own critical infrastructure facilities with internal power supply networks or critical infrastructure facilities (upon agreement with the local government);
- the specifics of the legal relationship between consumers and producers of electricity at KSU with a capacity of up to 20 MW for the period of emergency or planned shutdown or restriction by the operator of the electricity distribution/transmission system have been regulated. In this case, electricity can be provided under the contract on backup power supply. Back-up power supply of consumer facilities is not an activity related to the supply and distribution/transmission of electricity, and can be carried out exclusively by electric networks that are separate from the UES of Ukraine;
- the peculiarities of connection to KSU with a capacity of up to 20 MW of electrical installations of critical infrastructure objects have been regulated;
- thermal energy production activities of economic entities are exempted from licensing, if the production of thermal energy is carried out without the purpose of selling it and is consumed for own needs, or if the total nominal active electric power (total installed thermal power) of which does not exceed 5 MW (4.3 Gcal/h), and which are used as a backup source of energy during power outages from the system operator's networks for critical infrastructure objects and/or objects of heat supply, water supply, drainage systems, social institutions (educational, healthcare institutions I (except sanatorium-resort establishments));
- the procedure for connecting generating units (gas turbine, gas piston, cogeneration, etc.) to electrical networks has been simplified.

In addition, the NEURC approved the draft resolution of the NEURC "On Approval of Changes to the Procedure for Connecting to Heat Networks" for the purpose of implementing (during martial law) a simplified procedure for temporary connection of heat generators, including cogeneration plants, to heat networks. The draft resolution passed the stage of public consultations and is in the final stage before adoption.

As of the end of 2021, the installed capacity of CHP and cogeneration plants was about 6 GW. All large thermal power plants were put into operation before Ukraine gained independence. Expected results: the ESU envisages a significant increase in CHP capacity due to the construction of biomass CHP, with the capacity of such installations reaching 4.1 GW in 2050.

PM_EE_WAM_05 Update of the Concept of implementation of state policy in the field of heat supply

Goal: determination of strategic directions for the development of the field of heat supply, taking into account the need to stimulate the transition to efficient district heating.

Legal basis: ESU.

Time frame: Within one year after the termination or abolition of martial law in Ukraine.

Responsible bodies/organizations: Ministry of Infrastructure, NEURC.

Description: In view of the fact that the current Concept of implementation of state policy in the field of heat supply ²³⁶ was approved before the introduction of the concept of "efficient district heating" into legislation, this program document needs to be updated. In particular, the updated version of the Concept should be based on the principle of "energy efficiency first" and contribute to the achievement of indicators of efficient district heating: the use of at least 50 percent of renewable energy or 50 percent of waste heat energy, or 75 percent of heat energy produced in the cogeneration process, or 50 percent of a combination of such energy and heat).

PM_EE_WAM_06 Improvement of the model of state regulation in the field of heat supply

Goal: streamlining the powers of state authorities and local self-government bodies to ensure the restoration and development of infrastructure in the field of heat supply, attracting investments and improving the quality of services (goods).

Legal basis: Law of Ukraine "On Natural Monopolies"; Law of Ukraine "On Heat Supply"; The Law of Ukraine "On the National Commission, which carries out state regulation in the spheres of energy and communal services".

Time frames: 2024-2025

Responsible bodies/organizations: NEURC, Ministry of Infrastructure.

Description: Today in Ukraine there is a dualistic system of the state side of the heat supply sphere: state regulation, licensing and tariff setting for business entities that the production of thermal energy at thermal power plants, thermal power plants, nuclear power plants and cogeneration plants is carried out by the National Energy and Mineral Resources and Energy Research and Development Committee of the Russian Federation. At the same time, licensing of thermal energy production activities at other types of installations, transportation and heat supply is carried out by regional and Kyiv city state (military) administrations, and tariffs are set by local government in accordance with the procedure determined by the Cabinet of Ministers of Ukraine ²³⁷. Such a system of state regulation creates a number of problematic issues:

- inefficient use of state funds due to the need to maintain parallel systems of state regulation;
- dispersal of information on business entities operating in the field of heat supply between the National Energy and Mineral Resources Commission, the Ministry of Infrastructure, regional and Kyiv city state (military) administrations and local government;
- there is no possibility to carry out an objective (by factor) analysis/monitoring of the activities of business entities that are in the spheres of regulation of various bodies to assess the general current situation in the industry and to timely identify potential threats to the sustainable functioning of enterprises in the field of heat supply;
- low level of control over the fulfillment of the requirements of the Licensing conditions for conducting business activities in the field of heat supply by regional and Kyiv city state (military) administrations;
- limited possibility of out-of-court settlement of disputes with the participation of enterprises that are not licensees of the NEURC;
- low level of investment attraction in the industry;
- unsettled existing conflict of interests in local government organizations, which at the same time act as a body for setting tariffs for enterprises engaged in production, transportation and supply of thermal energy, owners of such enterprises and consumers of thermal energy.

²³⁶

<https://zakon.rada.gov.ua/laws/show/569-2017-%D1%80#Text>

²³⁷ <https://zakon.rada.gov.ua/laws/show/869-2011-%D0%BF#Text>

In the Concept of the State Targeted Economic Program for the Energy Modernisation of State- or Communal-Owned Thermal Energy Producers for the Period Until 2030²³⁸, the Government states that the policy of local and state authorities on the development of centralized heat supply systems is inconsistent and unbalanced.

In order to solve these problematic issues, NKREC, together with the Ministry of Infrastructure of Ukraine, with the involvement of representatives of the USAID Energy Security Project, are currently working on the issue of optimizing the regulation model of the heat supply industry, in particular issues of tariff formation, formation and implementation of investment programs by business entities whose activities are licensed by regional and Kyiv city state authorities (military) administration, introduction of mandatory 5-year investment planning based on city heat supply schemes, as well as effective mechanisms for monitoring the implementation of investment programs and targeted use of funds included by authorized bodies in thermal energy tariffs.

PM_EE_WAM_07 Settlement of debts of heat supply enterprises for consumed natural gas

Goal: improving the financial condition of heat supply enterprises.

Legal basis: Law of Ukraine "On peculiarities of regulation of relations on the natural gas market and in the field of heat supply during martial law and subsequent restoration of their functioning".

Time frame: 2024

Responsible bodies/organizations: Ministry of Infrastructure.

Description: On July 29, 2022, the Verkhovna Rada of Ukraine adopted the Law of Ukraine "On the peculiarities of regulating relations in the natural gas market and in the field of heat supply during martial law and the subsequent restoration of their functioning." In accordance with this Law, a moratorium has been introduced on tariff increases in the field of heat supply, in particular for heat energy (its production, transportation and supply) for the population, heat energy supply services for the population and hot water supply for the population. At the same time, the Law of Ukraine establishes that economic entities that produce and/or transport and/or supply thermal energy and provide thermal energy and hot water supply services, in respect of which a moratorium has been introduced, shall be compensated for arrears from the difference in production tariffs, transportation and supply of thermal energy, for thermal energy, services for district heating and centralized hot water supply, services for the supply of thermal energy and hot water supply, subject to settlement under the conditions and in the manner determined by the Law of Ukraine "On Measures Aimed at Debt Settlement of heat supply and heat generating organizations and enterprises of centralized water supply and drainage".

However, in 2022-2023, compensation for the difference in tariffs was not provided, which had a significant impact on the financial and economic condition of heat supply enterprises, led to an increase in the payables of these enterprises for consumed energy, the imposition of fines and seizure of accounts. The amount of arrears from the difference in tariffs for heat supply, which is confirmed by the protocols of territorial commissions, amounts to UAH 34.9 billion. Based on the results of the audit, the Government will work out a mechanism for settling confirmed debts.

In accordance with the Memorandum with the International Monetary Fund (IMF), the issue of conducting an independent audit company's analysis of the debt due to the difference in tariffs and the financial condition of heat supply enterprises is being worked out.

²³⁸ <https://zakon.rada.gov.ua/laws/show/1093-2023-%D1%80#Text>

At the same time, as of April 25, 2024, the debt of heat energy producers (heat supply enterprises, condominiums/residential buildings, managers of apartment buildings) for consumed natural gas amounts to UAH 100.4 billion, which significantly exceeds the amount of the difference in heat supply tariffs. Therefore, ensuring the repayment of debts from the difference in tariffs to heat supply enterprises is a necessary but not sufficient condition for improving the financial condition of enterprises and attracting investments. In order to improve the financial condition of heat supply enterprises, the Government plans to develop and approve changes to the legislation of Ukraine regarding:

- cancellation of the moratorium on the increase of thermal energy tariffs for the population (except for territories where active hostilities are taking place or temporarily occupied territories according to the list approved by the Ministry of Reintegration);
- reimbursement of arrears of the difference in tariffs for housing and communal services, in respect of which a moratorium has been introduced from both the state and local budgets;
- reimbursement of arrears of the difference in tariffs based on the results of an audit regarding the reliability of the amounts of such arrears and after repayment of accounts payable under restructuring agreements, which exceeds the amount of arrears of the difference in tariffs;
- introduction of the mechanism of current accounts with a special mode of use with the replacement of the guaranteed supplier with a business entity assigned special responsibilities by amending the Law of Ukraine "On Heat Supply".

In the event that the State Budget of Ukraine does not have expenses for financing the difference in tariffs for thermal energy, the debt for natural gas of thermal energy enterprises to suppliers of natural gas in the amount corresponding to the size of the difference in tariffs will be subject to installments in accordance with the procedure and for the terms established by the Cabinet of Ministers of Ukraine .

The Cabinet of Ministers of Ukraine has developed a draft of the Law of Ukraine "On Amendments to Certain Laws of Ukraine Regarding the Settlement of Accounts Payable of Heating, Water Supply and Sewerage Enterprises" (Reg. No. 11273 of May 20, 2024). This draft law proposes to determine the mechanism for restructuring the debt of heat supply companies for natural gas consumed after June 1, 2021, the specifics of charging (write-off) fines charged on the debt for natural gas, as well as taking executive actions against heat supply companies that will restructure the debt according to the conditions Law of Ukraine "On measures aimed at settlement of debts of heat supply and heat generating organizations and enterprises of centralized water supply and drainage". In addition, the draft law contains provisions on:

- entrusting the Cabinet of Ministers of Ukraine with powers to coordinate the activities of ministries and other central executive bodies in the field of development of normative legal acts on the formation of tariffs (prices) for thermal energy and determining the order of formation of tariffs for thermal energy, its production, transportation and supply, which are established LGUs, in particular, based on the principles of stimulating tariff formation;
- stimulation of energy-saving measures by heat-generating, heat-transporting and heat-supplying organizations before the implementation of energy-efficient measures by fixing tariffs at the level established before the implementation of such measures for three years.

At the same time, a new approach to establishing long-term tariffs on the basis of benchmarking for all types of activities in the field of heat supply is being developed by the NERCP: production, transportation and supply of thermal energy.

It is expedient to agree on the approaches to setting tariffs both for licensees of the NEURC and for licensees of regional and Kyiv city state (military) administrations.

PM_EE_WAM_08 Assessment of the application potential of efficient district heating and highly efficient cogeneration

Goal: increasing the efficiency of heat production and transportation, identifying the optimal set of energy-efficient measures, stimulating investments in energy-efficient measures.

Legal basis: Law of Ukraine "On Energy Efficiency"; Law of Ukraine "On combined production of heat and electricity (cogeneration) and use of waste energy potential".

Time frame: 2021 - indefinitely.

Responsible bodies/organizations: Ministry of Infrastructure.

Description: The assessment of the potential for the use of efficient district heating and highly efficient cogeneration is carried out at the local and national level. At the local level, the assessment of the potential for the use of efficient district heating and highly efficient cogeneration is a separate section of the heat supply scheme, developed on the basis of a cost-benefit analysis, and includes, in particular:

- description and map of the territory indicating existing and potential objects of heat energy consumption, existing and planned objects in the field of heat supply, potential sources of heat energy, including industrial installations or other objects that generate waste heat energy;
- assessment of the energy and technical potential of using effective district heating and highly efficient cogeneration;
- calculation of the target for saving primary energy;
- assessment of local, regional, state and international support programs for the production, transportation and supply of thermal energy, indicating, if available, the potential share of grant aid.

Assessments of the potential for the use of highly efficient cogeneration are mandatory at the level of individual installations in the case of a significant renewal of an existing or construction of a new heat generating installation (with a thermal capacity of more than 20 MW) before the start of work on its construction, capital repair, reconstruction or technical re-equipment. It should be noted that this provision of the Law of Ukraine "On the combined production of thermal and electricity (cogeneration) and the use of waste energy potential" should be brought into line with Directive 2012/27/EU.

Every five years, the Ministry of Infrastructure must approve a national report on a comprehensive assessment of the potential for the use of efficient district heating and highly efficient cogeneration and submit it to the Secretariat of the Energy Community. The necessary preparatory stage for the preparation of the national report is the approval of the Procedure for the development of the national report on the comprehensive assessment of the potential for the use of efficient district heating and highly efficient cogeneration. Currently, the Ministry of Infrastructure is developing this Procedure and will complete work on the regulatory act in the fourth quarter of 2024. After that, the preparation of the national report will begin.

PM_EE_WEM_18 Heat supply schemes

Goal: planning the most cost-effective heat supply of the settlement, reducing the amount of energy resources needed for the production, transportation and supply of a unit of heat energy to consumers.

Legal basis : Law of Ukraine "On Heat Supply"; order of the Ministry of Infrastructure of October 2, 2020 No. 235 "On approval of the Methodology for the development of heat supply schemes for populated areas of Ukraine" registered in the Ministry of Justice on November 18, 2020 under No. 1144/35427; order of the Ministry of Regions of April 28, 2020 No. 101 "On approval of the Procedure for approval by the Ministry of Regions of heat supply schemes for settlements with more than 20,000 inhabitants and regional programs for the modernisation of heating systems", registered in the Ministry of Justice on June 23, 2020 under No. 564/ 34847.

Time frames: 2005 - indefinitely.

Responsible bodies/organizations: Ministry of Infrastructure; local self-governments.

Description: The heat supply scheme is a tool for long-term planning of heat supply in populated areas, which is formed on the basis of an optimal combination of district and autonomous heating systems. The basis for the development of the heat supply scheme is the general plan of the settlement. Heat supply schemes are developed using the cost-benefit analysis method to select the recommended heat supply scenario. The long-term planning of heat supply of the settlement is aimed at the development of efficient systems of district heating, with the gradual replacement of traditional sources of heat energy using natural gas by:

- installations for the combined production of heat and electricity (cogeneration installations);
- installations that use renewable energy sources;

- installations for the use of waste thermal energy.

When developing heat supply schemes, areas of application of district, autonomous and individual heating systems are determined. The term of validity of such documents is 10 years. Heat supply schemes for settlements with more than 20,000 inhabitants are approved by the Ministry of Infrastructure, and approved by the local government.

The methodology for developing heat supply schemes for populated areas of Ukraine should be revised with the aim of a gradual transition to effective district heating ²³⁹ and taking into account the need to define zones of district, autonomous and individual heating.

To ensure compliance with the principle of "energy efficiency first", projects of modernisation of heat sources and heat networks must be developed taking into account the planned and carried out thermal modernisation of buildings. Currently, thermal modernisation is carried out in individual buildings, at the same time, the Long-term strategy of thermal modernisation of buildings until 2050 foresees a significant increase in the scale of thermal modernisation. Thermal modernisation of buildings and district heating systems should be carried out in a coordinated manner within the framework of an integrated approach.

As of November 2023, heat supply schemes were approved and remain in force in 30 settlements with a population of more than 20,000. Another 96 settlements need to develop or update heat supply schemes.

PM_EE_WEM_19 Qualification of cogeneration plants

Goal: establishing compliance with the conditions and indicators of operation of the cogeneration plant with the requirements of the law.

Legal basis: Law of Ukraine "On the combined production of heat and electricity (cogeneration) and the use of waste energy potential".

Time frames: 2024 - indefinitely.

Responsible bodies/organizations: SAEE.

²³⁹ According to the Law of Ukraine "On Energy Efficiency", effective district heating system is a system of district heating that uses at least 50% of renewable energy or 50% of waste heat energy, or 75% of heat energy produced in the cogeneration process, or 50% of the total of such energy and heat

Description: Cogeneration plants can be recognized as qualified if they are highly efficient cogeneration plants based on the results of primary energy savings calculations conducted in accordance with the methodology for determining the efficiency of the cogeneration process. Such a methodology must be developed and approved by the Ministry of Infrastructure.

Stimulating policy instruments for the use of qualified cogeneration plants are currently exemption from excise tax in the amount of 3.2% (subparagraph 213.2.8 of paragraph 213.2 of Article 213 of the Tax Code of Ukraine) for the sale of electricity produced by qualified cogeneration plants and the possibility of obtaining guarantees of the origin of electricity produced by a highly efficient cogeneration plant.

PM_EE_WAM_09 Guarantees of the origin of electricity produced by a highly efficient cogeneration plant

Goal: to provide the final consumers of electricity with information that the electricity is produced by a highly efficient cogeneration plant.

Legal basis: Law of Ukraine "On the combined production of heat and electricity (cogeneration) and the use of waste energy potential"

Time frames: 2024 - indefinitely.

Responsible bodies/organizations: SAEE.

Description: The owner (user) of a highly efficient cogeneration plant has the right to receive a guarantee of the origin of the electricity produced by a highly efficient cogeneration plant. Guarantees of origin in the form of an electronic document are provided by the State Energy Efficiency Agency free of charge. The guarantee of origin corresponds to the standard amount of electricity released into the network, which is determined with an accuracy of 1 MWh. The guarantee of origin is valid for 12 months. In order to obtain guarantees of origin for the produced electrical energy, the owner (user) of a highly efficient cogeneration plant must first pass the qualification of the cogeneration plant.

PM_EE_WAM_10 Stimulation of the development of highly efficient cogeneration

Goal: stimulation of investments in highly efficient cogeneration.

Legal basis: Law of Ukraine "On the combined production of heat and electricity (cogeneration) and the use of waste energy potential".

Time frame: 2025 - indefinitely.

Responsible bodies/organizations: Ministry of Infrastructure.

Description: Among the key measures to ensure distributed local generation, it is necessary to stimulate the installation of new cogeneration plants. There is a significant potential for the interaction of UES with existing systems of centralized heat supply for balancing WPPs and SPPs. To realize this potential, as well as to ensure a stable electricity and heat supply, the construction of new maneuverable cogeneration plants is necessary. Such installations can be supplemented with heat pumps or electric boilers together with thermal accumulators to use the surplus of electricity in the hour of the nighttime failure of the electricity load schedule for the production and accumulation of thermal energy.

Currently, the general legal regulation of the combined production of heat and electricity (cogeneration) is extended to highly efficient cogeneration plants, including the simplification of the procedure for connecting to electric and heat networks (regarding heat networks - the draft resolution of the NEURC is at the final stage before adoption).

Provided by the Law of Ukraine of February 24, 2023 No. 2955-IX "On Amendments to the Law of Ukraine "On the Combined Production of Thermal and electricity (Cogeneration) and the Use of Waste Energy Potential" on the Development of Highly Efficient Cogeneration" guarantees the origin of electricity produced by highly efficient cogeneration installation is not a sufficient incentive to attract financing for the construction of new capacities. In view of the current installation of cogeneration plants with the help of Ukrainian partners, an analysis of policy alternatives will be conducted to stimulate the construction of new highly efficient cogeneration facilities.

During October 2023 - February 2024, USAID, through the Energy Security Project, purchased 91 cogeneration plants for 32 Ukrainian cities and two universities, all of which meet the definition of high-efficiency cogeneration.

PM_EE_WEM_20 Provision of heat metering

Goal: providing consumers with accurate information about the volume of utility services consumed (heat energy supply, hot water supply, centralized water supply)

Legal basis: Law of Ukraine "On commercial accounting of thermal energy and water supply"; order of the Ministry of Regions of August 9, 2018 No. 206 "On approval of the Procedure for equipping buildings with commercial accounting units and engineering system equipment to ensure such accounting"; order of the Ministry of Regions of August 9, 2018 No. 205 "On approval of the Procedure for equipping individual premises in buildings with distribution metering units/heat energy distribution devices and engineering system equipment to ensure such metering"; Resolution of the Cabinet of Ministers of Ukraine of October 10, 2018 No. 829 "On Approval of the Procedure for Determining the Technical Feasibility of Installing Thermal Energy Distribution Metering Units and the Economic Feasibility of Installing Devices - Thermal Energy Distributors" (Official Gazette of Ukraine, 2018, No. 82, Article 2725).

Time frames: 2017 - indefinitely.

Responsible bodies/organizations: Ministry of Infrastructure; SAEF.

Description: The Law of Ukraine "On Commercial Accounting of Thermal Energy and Water Supply" introduces mandatory commercial accounting of thermal energy and water supply. This Law prohibits the connection of residential and non-residential buildings to external engineering networks without equipping such buildings with nodes for commercial accounting of relevant utility services. New residential and non-residential buildings that have been completed are put into operation only if these buildings and their premises are equipped with appropriate commercial and distribution accounting units.

The duty to install commercial accounting nodes rests with the operator of external engineering networks (the owner of external engineering networks or the person to whom such networks have been transferred for use). The owner (co-owners) of the building can also independently equip the building with commercial accounting units in accordance with the procedure established by law. The costs of the operator of external engineering networks for equipping existing buildings with commercial water and heat energy metering units are included in the tariffs for the relevant utility services. The law of Ukraine also provides for the possibility of allocating funds for equipping existing buildings with commercial accounting units from local budgets and from the state budget.

100 percent commercial accounting of thermal energy must be ensured within 24 months from the date of termination or cancellation of martial law in Ukraine. Initially, the achievement of this indicator was planned for August 3, 2018, later it was postponed to September 1, 2022, and postponed for the third time by the Law of Ukraine "On the peculiarities of the regulation of relations in the natural gas market and in the field of heat supply during martial law and the subsequent restoration of their functioning ". To ensure 100 percent accounting of thermal energy, it is necessary to assess the necessary financial resources and establish the obligation to include the necessary funds in the investment programs of operators of external engineering networks or provide financing from other sources (financing from the State Targeted Economic Program for the Energy Modernisation of Heat Generating Enterprises, which are in state or communal ownership, for the period until 2030 (PM_EE_WAM_08)).

The Law of Ukraine "On Commercial Accounting of Heat Energy and Water Supply" also regulates distribution accounting of heat energy. Installation of heat energy distribution metering units is mandatory before commissioning of new residential and non-residential buildings. If it is not technically possible to equip the district heating system of the house with distribution accounting nodes, the distribution accounting of consumed thermal energy in individual rooms in buildings is carried out with the help of thermal energy distribution devices, except for cases when it is economically impractical. Indications of devices - thermal energy distributors are used in the distribution of the amount of thermal energy consumed in the building only on the condition that at

least 50 percent of the heating devices (except those located in common areas of apartment buildings) in the building are equipped with such devices.

As of January 20, 2024, 84.9% of residential buildings and 83.9% of non-residential buildings are equipped with commercial heat energy metering units²⁴⁰.

PM_EE_WAM_11 Implementation of the State Targeted Economic Program for the Energy Modernisation of State- or Communal-Owned Thermal Energy Producers for the Period Until 2030

The goal: increasing the efficiency of the district heating systems of populated areas, reducing the specific consumption of fuel and energy resources and increasing the share of use of renewable energy, waste heat energy, and heat energy produced in the cogeneration process in the district heating systems.

Legal basis: Law of Ukraine "On Energy Efficiency"; Decree of the Cabinet of Ministers of Ukraine of November 28, 2023 No. 1093 "On Approval of the Concept of the State Targeted Economic Program for the Energy Modernisation of State- or Communal-Owned Thermal Energy Producers for the Period Until 2030" (Official Gazette of Ukraine, 2024, No. 3, Article 111).

Time frames: 2024-2030

Responsible bodies/organizations: Ministry of Infrastructure.

Description: The measures envisaged by the Concept of the State Targeted Economic Program for the Energy Modernisation of State-owned or communally owned heat energy producing enterprises for the period up to 2030 include:

- support and stimulation of LGUs in the development and updating of heat supply schemes in populated areas by reimbursing part of the cost of works;
- reimbursement of a part of the cost of work on the development and updating of heat supply schemes for settlements;
- stimulating enterprises in the field of heat supply to equip consumer buildings with commercial accounting nodes (in particular, with remote data transmission) to ensure 100 percent of commercial accounting of thermal energy.
- provision of co-financing for LGUs and enterprises in the field of heat supply for equipping buildings with individual heating points with automatic regulation depending on changes in weather conditions.
- partial reimbursement of the cost of major repairs and reconstruction of heat supply facilities of local government and enterprises in the field of heat supply;
- partial reimbursement of local government organizations and enterprises in the field of heat supply for the cost of measures provided for by the current scheme of heat supply.

²⁴⁰ https://sae.gov.ua/sites/default/files/Oblik_20_01_2024.pdf

Expected results of the Program:

- reduction of the annual consumption of natural gas in the amount of more than 1 billion m³;
- reduction of annual greenhouse gas emissions in the amount of about 2 Mt CO₂-eq;
- reducing the specific consumption of conventional fuel for the production of thermal energy to 150 kg of fuel/Gcal;
- reduction of the share of thermal energy losses in heating networks is up to 11 percent;
- increasing the share of the use of alternative energy sources in the production of thermal energy to 30 percent;
- provision of 100 percent of commercial thermal energy accounting.

The Ministry of Infrastructure sees the expected cost of modernisation of Ukraine's district heating systems in the range from 4 to 15 billion euros.

vii. Regional cooperation in this area, where applicable

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viii. Financing measures, in the area at national level

Name of the funding program	Source financing	Term implementation	Amount financing	Goal
State target economic program of energy efficiency and development of the sphere of production of energy carriers from renewable energy sources and of alternative fuels for 2010-2021 years	State budget of Ukraine	2010-2021	UAH 3.8 billion	Bringing the energy intensity of Ukraine's gross domestic product closer to the level of developed countries and European Union standards, optimizing the structure of the state's energy balance.
Energy Efficiency Fund	State budget of Ukraine	2018-2023	UAH 2.8 billion	Support for the implementation of measures to increase the level of energy efficiency of buildings, in particular in the residential sector, reducing carbon dioxide emissions
Decarbonisation and Energy-Efficient Transformation Fund	State budget of Ukraine	2024	UAH 759.2 million	Ensuring a sustainable source of funding, supporting state programs for energy efficiency, alternative energy sources and decarbonisation.
Energy efficiency support program in Ukraine - EE4U	European Neighborhood Instrument	2018 - 2025	104 million euros	Support for the activities of the Ukrainian Energy Efficiency Fund; raising awareness and supporting investments in energy efficiency measures by the general public at the local level, familiarization with measures of

				energy saving and popularization of the support mechanisms of the Energy Efficiency Fund; training of energy auditors to support the implementation of reforms in the field of energy efficiency and preparation and verification of the activities of the Energy Efficiency Fund
Urban infrastructure development project - 2	International Bank for Reconstruction and Development	2014 - 2024	326.6 million dollars. USA	Improving the quality and efficiency of water supply, drainage and household waste treatment services in selected cities of Ukraine.
Project "Improving energy efficiency in the district heating sector of Ukraine"	International Bank for Reconstruction and Development	2014 - 2023	202 million dollars. USA (part of the loan in the amount of USD 180 million was canceled)	Provision of assistance to utility enterprises - project participants in increasing economic and energy efficiency, minimizing the cost of fuel and energy resources, improving their institutional potential and investing in increasing the reliability of the functioning of heat supply systems due to works on the reconstruction of district heating systems (generation and transportation of heat), as well as improving the ecological situation of the regions.
Project "Municipal Infrastructure Development Program of Ukraine"	European Investment Bank	2016 - 2025	400 million euros	Implementation of projects aimed at reconstruction, renewal and/or minimization of infrastructure deterioration in the areas of: heat supply, water supply and drainage. energy efficiency of buildings, external lighting of settlements, handling of household waste.
Project "Energy efficiency of public buildings in Ukraine"	European Investment Bank	2021 - 2025	100 million euros	Increasing the energy efficiency of buildings owned by local government (including kindergartens, hospitals, schools, cultural and administrative buildings).
ESP Foundation "Eastern European partnership with energy efficiency and environment"	European Bank for Reconstruction and Development	2009 - 2029	137.5 million euros	Support for investments in municipal infrastructure, which are designed to increase energy efficiency in Ukraine, as well as to positively influence the environment and the fight against climate change

"Energy efficiency in communities" project	KfW - German Credit Institution for Reconstruction	2021 - 2025	25.5 million euros	Increasing the energy efficiency of selected buildings of the budgetary sphere in the cities of Zhytomyr and Zaporizhia by conducting thermal modernisation of public buildings, which should contribute to a significant reduction of the expenditures of the city budgets for paying for energy carriers
Project "Refinancing of energy-efficient investments of small and medium-sized enterprises of Ukraine through the financial sector"	KfW - German Credit Institution for Reconstruction	2022 - 2052	7.4 million euros	Financing of eligible Ukrainian financial institutions by providing sub-loans to Ukrainian small and medium-sized enterprises and private entrepreneurs for the purpose of financing investments in energy efficiency

3.3. Dimension energy security

i. Policies and measures related to the elements set out in point 2.3

PM_ES_WEM_01 Development of routes for the imports of petroleum products and natural gas

Goal: Maintaining diversification of the supply of oil products, natural gas; utilization of infrastructure (GTS, oil products pipelines)

Legal basis: ESU

Time frame: until 2025/2032, depending on the tasks

Responsible bodies/organizations: Ministry of Energy

Description: Before the full-scale invasion of the Russian Federation into Ukraine, the fuel market was 80% dependent on imports, mainly from the Russian Federation and the Republic of Belarus; also, a significant part of imports came by sea. During 2022, a complete change in the situation took place: the destruction of oil refining facilities led to almost 100% import dependence, the blockade of sea ports made it impossible to import via this route, thus a complete diversification of the sources and routes of supply of petroleum products and liquefied petroleum gas (LPG) was ensured. In the future, the geography of imports will be affected by the speed of unblocking the operation of sea ports and the restoration of oil refining industry.

The 2050 Energy Strategy of Ukraine foresees among the strategic initiatives and tasks:

- by 2025: diversification of technologies and supply routes in order to eliminate possible energy crises and shortages in the event of emergency situations;
- by 2032: expansion of oil product supply channels from the EU-based refineries and ports.

In the natural gas market, the task by 2025 is to diversify supply routes in order to eliminate possible energy crises and shortages in the event of emergency situations, including the creation of routes for the import of liquefied natural gas (LNG).

A long-term initiative is the creation of a gas hub, which includes providing access to LNG terminals in Poland, Greece, Croatia, Turkey, Italy and Germany. The practical implementation of the policy will depend on market actors - gas imports from LNG terminals can be implemented both through long-term contracts and through the purchase and reservation of available free volumes on the spot markets through swap operations and adjacent routes.

PM_ES_WAM_01 Incentives for increasing gas production for maximum self-sufficiency

Goal: Maintaining diversification of natural gas supply; utilization of infrastructure (GTS); providing the economy with own resources

Legal basis: ESU

Time frame: until 2025/2032, depending on the tasks

Responsible bodies/organizations: Ministry of Energy, State Geological Survey

Description: The 2050 Energy Strategy of Ukraine provides, in particular, among strategic initiatives and tasks:

- by 2025:
 - Increase in production under PEC contracts;
 - Implementation of production sharing agreements signed in 2020-2022 for 11 fields with hydrocarbon deposits;
 - Research and industrial development of plots that extractive companies received on the basis of electronic auctions;
 - Active involvement of international service companies with modern technologies by extractive companies;
- by 2032:
 - Involvement of investors in the conclusion of new PSAs;
 - Making changes to the legislation and providing tight gas a separate legal status, as a separate mineral;
 - Attracting investments to increase gas production at existing fields, development of gas fields of unconventional deposits;
 - Adoption of normative acts regarding the rules for resuming operation of mothballed and liquid wells.

Subject to the implementation of the strategic initiatives specified in the ESU, the forecast volume of extraction by 2030 will be approximately 21.5 bcm. The start of production is predicted in 2025-2032. By 2032, private companies should produce 5.8 bcm annually, state-owned ones (Ukrnafta, Ukgazvydobuvannya) - about 15.5 bcm. The total volume of investments is estimated at about UAH 100 billion by 2030.

In an optimistic scenario, by 2032, private companies should produce 6.7 bcm annually, state-owned companies - 20.1 bcm. The total amount of investments is estimated at about UAH 150 billion by 2030. At the same time, reaching the total extraction volume of 26.8 bcm will be possible only at the expense of investments in new deposits, including development of tight gas deposits and the Black Sea offshore.

According to the information received during the consultations, it is realistic to maintain the production volumes at the current level with a small increase, which will allow to slightly reduce the dependence on imports. The transition to full self-sufficiency in domestic consumption by 2030 is possible under the conditions of additional measures to support biomethane production and reduce domestic consumption of natural gas. Continuation of this policy will make it possible to count on the exports of residual volumes (or an increase in the production of goods that require the use of gas as a commodity) in the later period.

See as well as policies and measures of the Dimension internal energy m.

PM_ES_WAM_02 Restoration of oil refining and/or construction of a new refining complex

Goal: Meeting the demand for oil products at the expense of domestic oil refining

Legal basis: ESU

Time frame: until 2025/2032, depending on the tasks

Responsible bodies/organizations: Ministry of Energy

Description: The 2050 Energy Strategy of Ukraine, aiming at the development of oil production and the restoration of oil refining on the basis of one of the existing refineries and/or the construction of a new complex, provides among the strategic initiatives and tasks:

- by 2025:
 - Conducting a feasibility study of the restoration of domestic oil refining and starting the relevant preparatory works;
- By 2032:
 - Facilitating the implementation of individual oil projects by improving geological research and establishing competitive fiscal conditions (including PSAs);
 - Identification and elimination of legislative barriers to increase the national production of petroleum products;
 - Stimulating the introduction of new oil extraction and preparation technologies that maximize energy efficiency (in particular, at state-owned enterprises);
 - Restoration of oil refining capacities through modernization/reconstruction on the basis of one of the existing refineries and/or construction of a new complex, where it is most economically feasible;
 - Increasing the level of technological equipment of refineries and supplementing them with new petrochemical processes, which increases their competitiveness;
 - Analysis of the development of small modular refineries;
 - Restoration and expansion of LPG production capacity up to 200,000 tons/year and of gas condensate up to 40,000 tons/year.

The recovery of the industry is aimed at partially covering the demand for petroleum products. The rest of the needs will be covered by diversified imports in order to maximize energy security (see PM_ES_WEM_01 Development of routes for the imports of petroleum products and natural gas).

A clear perspective of the industry's development is also an important component of the policy to reduce emissions of methane and non-methane volatile organic compounds during oil and gas processing.

PM_ES_WEM_02 Creation of fuel assemblies production capacity to meet at least 50% of the needs of Ukrainian nuclear power plants

Goal: Increasing own production capacity and increasing the share in meeting the needs of Ukraine's nuclear power plants

Legal basis: ESU

Time frames: 2024-2027

Responsible bodies/organizations: Ministry of Energy, JSC "NAEK "Energoatom"

Description: In Ukraine, it is planned to increase the installed capacities of nuclear power plants due to the construction of new power units, as well as the implementation of a project on the own production of fuel assemblies. The 2050 Energy Strategy of Ukraine, among the strategic initiatives and tasks until 2032, also provides for its own production of assemblies for nuclear reactors.

By 2025, JSC NAEK Energoatom planned to launch at its separate division Atomenergomash a full capacity production of fuel assemblies to meet all the needs of Ukrainian nuclear power plants²⁴¹. In 2021, Atomenergomash began work on establishing the production of nuclear fuel (fuel assemblies) using Westinghouse technology with the aim of completely replacing fuel of Russian origin. On January 17, 2022, Energoatom JSC and Westinghouse entered into an agreement on the evaluation and qualification of production lines for the production of fuel assemblies. In 2023, the plans were adjusted: Energoatom JSC plans to develop its own nuclear fuel production line starting in 2024, which will cover 50% of the needs of Ukrainian nuclear power plants; the project will take 3 years to implement²⁴².

PM_ES_WAM_03 Creation of fuel assemblies production capacity to meet all the needs of Ukrainian nuclear power plants

Goal: Increasing own production capacity and increasing the share in meeting the needs of Ukraine's nuclear power plants

Legal basis: ESU

Time frames: 2025-2032

Responsible bodies/organizations: Ministry of Energy, JSC "NAEK "Energoatom"

Description: The implementation of the project on the construction of an installation for the production of heat-releasing assemblies for nuclear reactors is expected, with the capacity to cover the needs of all nuclear power units of Ukraine. At least, JSC NAEK Energoatom planned to bring its separate unit Atomenergomash to full capacity in the production of fuel assemblies to meet all the needs of Ukrainian nuclear power plants by 2025²⁴³.

The 2050 Energy Strategy of Ukraine, among the strategic initiatives and tasks until 2032, also provides for its own production of heat-releasing assemblies for nuclear reactors.

PM_ES_WAM_04 Development of uranium production

Goal: Increasing own production capacity and increasing the share in meeting the uranium needs of Ukraine's nuclear power plants at the expense of natural resources and technological capacities

Legal basis: ESU, Concept of the State Targeted Economic Program for the development of the nuclear industrial complex for the period until 2026²⁴⁴, the draft State Targeted Economic Program for the development of the nuclear industrial complex for the period until 2028²⁴⁵

Time frames: 2024-2028

Responsible bodies: Ministry of Energy

Description: The development of nuclear energy in Ukraine will require an increase in production and an increase in the efficiency of uranium ore processing, taking into account the presence of a significant amount of explored reserves and promising resources, effective extraction and processing technology.

²⁴¹ <https://www.energoatom.com.ua/setting-up-production.html>

²⁴² <https://www.energoatom.com.ua/o-3011232.html>

²⁴³ <https://www.energoatom.com.ua/setting-up-production.html>

The draft State Targeted Economic Program for the Development of the Nuclear Industrial Complex for the period until 2028 provides for the support to SE "ShidGZK" - the only enterprise that produces and processes uranium ores in Ukraine, covering up to 40% of needs. As a result of the implementation of the Program, it is assumed to:

- fully cover the demand of the domestic nuclear industry in uranium for the production of fresh nuclear fuel;
- increase the level of energy independence of Ukraine and ensure the development of the domestic nuclear industrial complex;
- preserve the existing facilities for mining and processing of uranium ores;
- increase the amount of uranium ore mining necessary to fully meet the demand of domestic nuclear power plants;
- maintain the volume of uranium production, taking into account the decommissioning of the Vatutinske uranium ore deposit;
- preserve and create new jobs, despite the decommissioning of the Smolinska mine of the Vatutinske uranium ore deposit from 2024;
- preserve the amount of revenues to the State Budget of Ukraine and local budgets of all levels;
- ensure reduction of the negative impact of uranium production on radiation safety and the environment.

Among the target indicators is the production output of 683 tons of natural uranium concentrate in 2028, which will be approximately 30% of current needs. At the initial stage, it is assumed that uranium raw materials will be transferred to foreign producers of nuclear fuel for domestic nuclear power plants.

The 2050 Energy Strategy of Ukraine actually repeats the provisions of the Concept and the draft Program, proposing among strategic initiatives and tasks:

- by 2025:
 - Maintenance of the existing capacities of the plant for the extraction of uranium ores;
 - Implementation of the state investment project "Novokostiantynivska mine. Development of production capacities";
 - Development of new uranium deposits;
- by 2032:
 - Increasing the volume of uranium production and reducing the costs of its production;
 - Increasing the efficiency of uranium ore processing and uranium production.

PM_ES_WEM_03 Creation of gas reserves (filling of gas storages)

Goal: Ensuring security of natural gas supply in Ukraine

Legal basis: Law of Ukraine "On the Natural Gas Market", Law of Ukraine of December 13, 2022, No. 2850-IX "On Amendments to Certain Legislative Acts of Ukraine Regarding the Certification of Gas Storage Operators and Continuation of Measures to Prevent the Bankruptcy of the State Joint Stock Company Chornomornaftogaz"²⁴⁶

Responsible bodies/organizations: Ministry of Energy

²⁴⁴ <https://zakon.rada.gov.ua/laws/show/1804-2021-%D1%80#Text>

²⁴⁵ <https://mev.gov.ua/proyekt-normatyvno-pravovoho-aktu/povidomlennya-pro-oprylyudnennya-proyektu-rozporjadzhennya-0>

²⁴⁶ <https://zakon.rada.gov.ua/laws/show/2850-20 #Text>

Description: The Law of Ukraine "On the Natural Gas Market" provides for the possibility of establishing an obligation on all suppliers to form an insurance reserve of natural gas in the amount of no more than 10% of the planned monthly supply to consumers for the next month. The size of the insurance reserve is set annually by the Cabinet of Ministers of Ukraine at the same level for all suppliers.

However, in recent years this level was zero, and the universal obligation was difficult to fulfill due to the projected financial burden on market participants and the administrative burden on state authorities. The level of the insurance reserve at 3%²⁴⁷ proposed by the Ministry of Energy in 2023 assumed that the costs associated with meeting the requirements would amount to UAH 848.5 million during the first 3-6 months.

Adopted in 2022, the Law of Ukraine of December 13, 2022, No. 2850-IX "On Amendments to Certain Legislative Acts of Ukraine Regarding the Certification of Gas Storage Operators and Continuation of Measures to Prevent the Bankruptcy of the State Joint Stock Company Chornomornaftogaz", which, inter alia, implements Articles 6a and 6c of the Regulation (EU) 2017/1938, defines the filling target as "the mandatory level of filling underground gas storages as of the relevant date, set as a percentage of the total capacity of underground gas storages, which is indicated in the schedule of filling gas storages". The development of the schedule is entrusted to the Ministry of Energy, monthly reports are submitted by the GSSO to the Ministry of Energy and the Regulator in accordance with the procedure provided by the Rules on the Security of Natural Gas Supply.

However, the regulatory framework needs improvement to fully implement the requirements of the Regulation (EU) 2017/1938 (see PM_ES_WAM_06 Implementation of EU rules on security of electricity and gas supply). This applies both to amendments to the Law of Ukraine "On the Natural Gas Market" in terms of the mechanisms for the target filling level of gas storage facilities, and to the Rules on the Security of Natural Gas Supply to include clear rules for calculating the target filling level of gas storage facilities and forming a gas storage filling schedule. In 2024, the Ministry of Energy published a corresponding draft order on changes to the Rules²⁴⁸.

The plan of measures for the preparation of housing and utility facilities and the fuel and energy complex of Ukraine for the autumn-winter period of 2023/24 and its completion provides for the creation of gas reserves in underground storage facilities in the amount of 14.7 bcm by November 1, 2023²⁴⁹. A separate decision of the Energy Community Secretariat²⁵⁰ approved the target indicators (including intermediate indicative targets) for the period until November 2024, submitted by Ukraine in accordance with the requirements of the law.

PM_ES_WEM_04 Creation of coal and backup fuel (fuel oil) reserves

Goal: Ensuring security of electricity supply

Legal basis: The procedure for forming the forecast balance of electricity of the Unified Energy System of Ukraine for the accounting year²⁵¹, the Rules on the Security of Electricity Supply²⁵², the decision of the government in the framework of preparation for the autumn-winter periods²⁵³

Responsible bodies/organizations: Ministry of Energy, market players

²⁴⁷

<https://mev.gov.ua/rehulyatornyy-akt/povidomlennya-pro-oprylyudnennya-do-proektu-postanovy-kabinetu-ministriv-ukrayiny>

²⁴⁸

<https://mev.gov.ua/rehulyatornyy-akt/povidomlennya-pro-oprylyudnennya-proyektu-nakazu-ministerstva-enerhetiky-14>

²⁴⁹

<https://www.naftogaz.com/news/naftogaz-group-fulfilled-the-plan-of-the-cabinet-of-ministers-of-ukraine>

²⁵⁰ <https://www.energy-community.org/news/Energy-Community-News/2023/11/15.html>

²⁵¹ <https://zakon.rada.gov.ua/laws/show/z1312-18#Text>

²⁵² <https://zakon.rada.gov.ua/laws/show/z1076-18#n17>

²⁵³ <https://zakon.rada.gov.ua/laws/show/515-2023-%D0%BF#Text>

Description: The formation and maintaining of reserves of fossil energy resources for generating facilities (natural gas, coal, fuel oil) is carried out as a measure within the framework of the government's activities to coordinate the preparation of the industry for each autumn-winter season. As a rule, target indicators are determined in the form of orders of the Cabinet of Ministers of Ukraine ²⁵⁴.

However, the basis is the forecast balance of electricity of the UES of Ukraine for the accounting year, which is compiled by the TSO and approved by the Ministry of Energy. In accordance with the Rules on the Security of Electricity Supply, to ensure the security of supply in the short term, the Ministry of Energy approves the Forecast balance of electricity of the UES of Ukraine, the coal accumulation schedule at the end of each month of the accounting year for electricity producers of thermal power plants and combined heat and power plants (no later than December 1, which precedes the forecast). Monitoring of security of supply is carried out, inter alia, regarding the schedule and volumes of supply and accumulation (reserves) of all types of fuel within the forecast balances of electricity production.

In accordance with a separate Procedure, the calculations of the basic and marginal variants of the balance must take into account assumptions regarding the volumes of own extraction (production) of fuel and its processing products, forecast prices, as well as the risk of insufficient fuel supply for generating facilities.

When determining the amount of fuel supply, the following should be taken into account:

- for TPPs:
 - o formation of guaranteed reserves of coal corresponding to 10- or 20-day volumes of consumption, depending on the remoteness of the point of its extraction;
 - o preventing reserve fuel (fuel oil) stocks from falling below the 10-day volume needed to ensure unit start-ups and necessary lighting;
- for CHPs:
 - o formation of guaranteed coal reserves corresponding to the 20-day average daily consumption required to ensure the heat load schedule in accordance with the concluded contracts for heat supply in the forecast month (at CHPs for which coal is the main fuel);
 - o preventing the reserve fuel (fuel oil) from falling below the 10-day volume required for unit start-ups and necessary lighting (at CHPs for which coal is the main fuel);
 - o preventing a decrease in the 10-day supply of reserve fuel (fuel oil) to ensure the survivability of CHPs and heat networks in the event of a complete shutdown of natural gas supply (at CHPs for which natural gas is the main fuel).

After approval of the forecast balance, electricity producers at TPPs and CHPs provide the Ministry of Energy with data on the forecast fuel structure. During the development of such forecasts, electricity producers at TPPs are obliged to ensure:

- supply of coal in the amount of planned costs in accordance with the approved forecast balance of electricity;
- the formation of guaranteed coal reserves corresponding to the 10-day (for the G+D grades) or 20-day (for the ASh+P grades) volume of average daily coal consumption (based on consumption data for the last three years and the weighting factor depending on the month).
- formation of a 10-day supply of reserve fuel (fuel oil) at TPPs, for which the main fuel is coal, for units start-ups and possible lighting.

²⁵⁴ For example <https://zakon.rada.gov.ua/laws/show/586-2021-%D1%80#Text>

In turn, producers of electricity at CHPs are obliged to ensure the formation of guaranteed reserves of coal and reserve fuel (fuel oil) at the same level as when determining the amount of fuel supply.

Based on the information received from the generating companies, the Ministry of Energy compiles a consolidated forecast structure of fuel for TPPs and CHPs, forms and approves the schedule for the accumulation of coal and reserve fuel (fuel oil) at the end of each month of the accounting year for TPPs and CHPs. Electricity producers at TPPs and CHPs also monitor the implementation of the approved schedule and, in the event of a decrease, inform the Ministry of Energy and TSO about the reasons and measures to bring fuel stocks in warehouses in line with the schedule. Monitoring of indicators of the forecast balance of electricity, in particular fuel reserves, is also carried out independently by both the Ministry of Energy and TSO.

Reduction of guaranteed coal reserves is allowed in case of force majeure in the supply of coal, as well as with the approval of the Ministry of Energy (but not more than 15% and for a period of up to 20 days). Volumes of guaranteed coal reserves must be restored within 20 days from the last day of the month when the reduction of these volumes began.

PM_ES_WAM_05 Creation of minimum stocks of crude oil and petroleum products

Goal: Ensuring uninterrupted supply of oil and petroleum products to the domestic market of Ukraine, in the event of a crisis situation on the oil and petroleum products market, by implementation of the requirements of the Council Directive 2009/119/EC, which provides for the creation of a level of minimum stocks equal to 90 days of average daily net imports or 61 days of average daily consumption, depending on which of the indicators is higher.

Legal basis: Law of Ukraine "On Minimum Stocks of Crude Oil and Petroleum Products"²⁵⁵

Time frame: In stages, with the achievement of the target volume within 8 years from the implementation (after 12 months from the date of entry into force); approximately until 2032-2033. At the same time, obligations to create minimum reserves of crude oil from the composition of the minimum stocks arise for market players 6 months after the termination or cancellation of martial law.

Responsible bodies/organizations: Ministry of Energy, State Customs Service, State Tax Service, State Statistics Service

Description: Ukraine has not yet created actual volumes of minimum stocks, which, along with the complete destruction due to the full-scale invasion of the Russian Federation in Ukraine, creates the risk of interruptions in the supply of petroleum products. If the supply of oil and petroleum products is stopped, the country will be able to satisfy its need for no more than 10-30 days at the expense of its own production and refining and available commercial stocks of petroleum products²⁵⁶.

The adopted Law defines the basic principles of the creation and operation of the minimum stocks system in Ukraine, and also regulates relations in this area (functions and powers of state control bodies, the administrator of the reporting system). The act defines the concept of a crisis situation on the market of oil and petroleum products, its levels, the procedure for creating, storing, and replacing the minimum stocks, as well as disclosure in the event of a crisis, the procedure for financing the operation of the minimum stocks system.

Military risks of creation of the minimum stocks are mitigated by the provision according to which, during the martial law, part of the stocks can be stored abroad in EU member states bordering Ukraine (no more than 50% of the total volume) and EU countries bordering such states (no more than 25% of the total volume). The 2050 Energy Strategy of Ukraine provides, among the strategic initiatives and tasks until 2025, the construction of protected storage facilities for the placement of oil reserves.

²⁵⁵ <https://zakon.rada.gov.ua/laws/show/3484-IX#Text>

²⁵⁶ <https://itd.rada.gov.ua/billInfo/Bills/pubFile/1853886>

Formed minimum stocks can be used only in crisis situations related to fuel supply disruptions and fuel shortages, and cannot act as a tool for regulating market prices. The law of Ukraine provides for liability for violation of the rules and conditions of storage of stocks.

In addition, JSC Ukrtransnafta is planned to be involved in the implementation of requirements for the storage of minimum stocks²⁵⁷. In particular, it is assumed that the operator of oil and petroleum products pipelines will act as a responsible custodian, and other companies will be the owners. At the same time, in order to implement this project, JSC Ukrtransnafta will have to take additional measures by increasing the tank fleet, taking into account the fact that the requirements of Council Directive 2009/119/EC prohibit storage in pipelines (similarly, the Law of Ukraine contains a restrictive definition of tanks).

PM_ES_WEM_05 Implementation of the first standard of conduct for gas infrastructure facilities (N-1 Standard), standards of conduct for gas suppliers

Goal: Ensuring the safety of natural gas supply in Ukraine by forecasting and assessing possible risks, taking measures to prevent them, eliminate or reduce damage from crises. Defining protected consumers, mandatory measures for market players.

Legal basis: Law "On the Natural Gas Market", Rules on the Security of Natural Gas Supply²⁵⁸, National Action Plan²⁵⁹

Responsible bodies/organizations: Ministry of Energy

Description: N-1 Standard stipulates that in the event of failure of the largest main gas pipeline or the largest gas storage facility, the capacity of the remaining gas infrastructure facilities on the territory of Ukraine must ensure the ability to meet peak demand (days when there is an extremely high demand, the statistical probability of which is once every 20 years). The annual calculation of the N-1 Standard is entrusted to the Ministry of Energy.

Also, all suppliers of natural gas are obliged to take measures to ensure a sufficient resource of gas for the needs of their consumers belonging to the protected category. Among the measures are maintenance of stocks in gas storage facilities, conclusion of purchase and sale contracts for additional volumes, restriction or termination of supplies to consumers that are not protected. Appropriate standards of conduct should be observed in the following cases:

- extreme temperatures during a 7-day peak period, the statistical probability of which is once in 20 years (Standard 1);
- a period of extremely high demand for natural gas lasting 30 days or more, the statistical probability of which occurs once every 20 years (Standard 2);
- failure of the main gas pipeline under normal winter conditions for a period of 30 days (Standard 3).

The Rules on the Security of Natural Gas Supply are regularly revised. The next update should take into account the measures necessary to meet the gas supply standard under all scenarios specified in Article 6(1) of the Regulation (EU) 2017/1938.

The Ministry of Energy is also responsible for the development and implementation of the National Action Plan, which defines measures to respond to crisis situations of various levels, as well as for the organization and monitoring of security of supply. Annual updates of the National Action Plan and publication of reports on the results of security of supply monitoring should take place. It is important to note that such revision is also due to the cooperation of the Ministry of Energy with the Joint Research Center of the European Commission.

²⁵⁷ <https://itd.rada.gov.ua/billInfo/Bills/Card/42196>

²⁵⁸ <https://zakon.rada.gov.ua/laws/show/z1489-15>

²⁵⁹ <https://zakon.rada.gov.ua/laws/show/z1458-15>

PM_ES_WEM_06 Fulfillment of the minimum criteria for the security of electricity supply

Goal: Determination of measures to ensure the security of electricity supply (both preventive and in case of violations), minimum criteria for security of electricity supply, mandatory measures for market players.

Legal basis: Law of Ukraine "On the Electricity Market", Rules on the Security of Electricity Supply²⁶⁰

Responsible bodies/organizations: Ministry of Energy, Regulator, TSO

Description: Most of the threats and their prevention/response measures are in the field of view of the TSO, which monitors compliance with the standards of operational security of supply (defined by the Transmission System Code²⁶¹). The Ministry of Energy is responsible for organizing and conducting monitoring security of supply (together with the Regulator, transmission system operator and other relevant institutions). Every two years, a report on the results of the security of supply monitoring should be published.

PM_ES_WAM_06 Implementation of EU rules on security of electricity and gas supply

Objective: Ensuring security of electricity and natural gas supply through risk assessment and preparation of action plans

Legal basis: EU legislation

Responsible bodies/organizations: Ministry of Energy, Regulator, TSO, DSOs, ENTSO-E, regional coordination centers (RCCs) and other parties

Description: For Ukraine, it is necessary to implement the requirements of EU legislation, in particular the Regulation (EU) 2019/941 on preparedness for risks in the electricity and the repeal of Directive 2005/89/EC, the Regulation (EU) 2019/943 on the internal electricity market (regarding the implementation of the electricity supply standard), as well as the Regulation (EU) 2017/1938 on measures to guarantee the security of gas supply and on the repeal of Regulation (EU) No. 994/2010 (except for the part on filling gas storages).

The Regulation (EU) 2019/941 requires the determination of the authorized body that must carry out a risk assessment of electricity supply taking into account the regional risk assessment (performed by ENTSO-E), prepare and approve a risk preparedness plan with a list of measures planned or taken for prevention, preparation and mitigation of crises. This plan should be prepared in accordance with Articles 11 and 12 of the Regulation and the template provided in the Annex to the Regulation, with the participation of all necessary stakeholders.

The Regulation (EU) 2019/943 requires the assessment of the resources adequacy at the national level, taking into account the results and parameters of the assessment of the resources adequacy at the EU level (performed by ENTSO-E). The regulation also provides for the possibility of applying capacity mechanisms. The methodology for assessing the adequacy of resources takes into account such components as the calculation of the volume of lost load (VoLL), the calculation of the cost of new market participant entry (CoNE), the definition of the Reliability Standard.

The Regulation (EU) 2017/1938 requires the designation of an authorized body that must carry out a coordinated regional assessment of gas supply risks, prepare and approve preventive action plans and emergency plans. These plans must be prepared in accordance with Articles 9 and 10 of the Regulation, as well as the templates provided in the annexes to the Regulation, with the participation of all necessary stakeholders. Implementation of the N-1 Standard and the infrastructure standard is reinforced by solidarity and cooperation measures at the regional level. In order to bring the Rules for Security

²⁶⁰ <https://zakon.rada.gov.ua/laws/show/z1076-18>

²⁶¹ <https://zakon.rada.gov.ua/laws/show/v0309874-18>

of Natural Gas Supply in accordance with the requirements of the Regulation (EU) 2017/1938, in 2023 the Ministry of Energy published draft amendments²⁶² in the part of conducting risk assessment in accordance with the form and requirements of the Regulation, in 2024 - another draft amendments²⁶³ in the part of risk assessment and calculation of target levels for filling gas storages and forming a schedule for filling gas storages.

PM_ES_WEM_07 Creation of a national system for the protection of CIF of the energy sector

Goal: Creation and functioning of the national system of protection of critical infrastructure of the energy sector

Legal basis: Energy Security Strategy, the Law of Ukraine "On Critical Infrastructure"²⁶⁴ and by-laws, the 2050 Energy Strategy of Ukraine, the National Plan for the Protection and Ensuring the Safety and Stability of Critical Infrastructure²⁶⁵ and separate decisions of the NSDC

Time frame: 2024-2025 (main measures of the National Plan for the Protection and Ensuring the Safety and Stability of Critical Infrastructure)

Responsible bodies/organizations: Ministry of Energy, Administration of the State Service for Special Communications and Information Protection of Ukraine, Ministry of Infrastructure

Description: The Energy Security Strategy identifies among the priority tasks for achieving Strategic Goal 2. Sustainability of the energy sector:

- introduction of a system of risk assessment and exchange of information about risks and threats to the critical infrastructure of the energy sector;
- formation of a system for preventing the realization of threats of any type and responding to crisis situations, introducing a plan for energy stability of Ukraine;
- introduction of a mechanism of cooperation and interaction between the state and operators of critical infrastructure of the energy sector in case of crisis situations, in particular regarding the involvement of state representatives in the participation and monitoring of the implementation of crisis response plans.

The crisis situation itself has the following definition: "violation or threat of violation of the regular mode of operation of the energy sector or critical infrastructure of the energy sector, which may cause the termination of energy supply to consumers in two or more regions of Ukraine, or a decrease in the level of energy supply to consumers by more than 40 percent, liquidation and restoration of regular working conditions which require special (emergency) measures".

At the same time, the Law of Ukraine "On Critical Infrastructure" is the basis for the implementation of the policy of protection of CIF. According to the State Service for Special Communications and Information Protection of Ukraine²⁶⁶ as the authorized body in the field of protection of critical infrastructure of Ukraine, their operators are directly responsible for the protection of CIF. The system functions in four modes: regular, preparedness and prevention of threats, response to the emergence of a crisis situation, restoration of regular functioning.

The authorized body coordinates the activities of the subjects of the national protection system, ensures the formation and implementation of state policy in the field of critical infrastructure protection. Formation and implementation of state policy in individual sectors

²⁶²

<https://mev.gov.ua/rehulyatornyy-akt/povidomlennya-pro-oprylyudnennya-proektu-nakazu-ministerstva-enerhetyky-3>

²⁶³

<https://mev.gov.ua/rehulyatornyy-akt/povidomlennya-pro-oprylyudnennya-proyektu-nakazu-ministerstva-enerhetky-14>

²⁶⁴

<https://zakon.rada.gov.ua/laws/show/1882-20#n132>

²⁶⁵

<https://zakon.rada.gov.ua/laws/show/825-2023-%D1%80#Text>

²⁶⁶

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is carried out by functional and sectoral bodies. Functional bodies (State Emergency Service, National Police, Security Service, etc.) participate in responding to crisis situations related to ensuring the safety and stability of critical infrastructure.

The relevant sectoral bodies in the field of critical infrastructure protection²⁶⁷ include the Ministry of Energy (fuel and energy sector) and the Ministry of Infrastructure (utility services, including heat energy supply, hot water supply).

Among the important powers, it is the sectoral bodies that develop and approve the requirements for the protection of CIF, project threats to critical infrastructure at the sectoral level, norms and regulations for the protection of critical infrastructure in the relevant sectors, compile and maintain sectoral lists of CIF, carry out, together with operators, the categorization of CIF, provide proposals for inclusion of CIF to the National Register²⁶⁸, approve the safety passport for each CIF, make a decision on the announcement of critical infrastructure operating modes, carry out verification and assessment of the security of CIF, organization of a system of personnel training, education and training to ensure stability and protection of critical infrastructure sectors

The functioning of the system should be carried out in four modes: full-time, preparedness and prevention of the realization of threats, response to the emergence of a crisis situation, restoration of full-time functioning. At the same time, the deployment of the CIF protection system is expected by the end of 2024 in accordance with the main measures of the National Plan for the Protection and Ensuring the Safety and Stability of Critical Infrastructure, approved in September 2023. In particular, the development and approval of industry plans and programs for countering threats to critical infrastructure (including emergency plans, crisis response plans, interaction plans, CIF recovery plans, etc.) is planned for Q2 2024.

In addition, in the conditions of conducting military operations, the organization of protection and security of the operation of CIF in the energy sector of Ukraine is also coordinated by the National Security and Defense Council.

PM_ES_WEM_08 Experiment on the construction, repair and other engineering and technical measures for the protection of CIF

Goal: Creation of multi-level engineering and technical protection of key critical infrastructure facilities of the fuel and energy sector

Legal basis: Resolution of the Cabinet of Ministers of Ukraine of December 27, 2022, No.1482 "On the implementation of an experimental project regarding the construction, repair and other engineering and technical measures for the protection of critical infrastructure facilities of the fuel and energy sector of critical infrastructure" (Official Gazette of Ukraine, 2023, No. 4, Article 310)²⁶⁹

Time frames: 2023-2024

Responsible bodies/organizations: Ministry of Infrastructure, State Agency for Restoration and Infrastructure Development (Restoration Agency)

Description: The coordinators of the project are the Ministry of Infrastructure and the Restoration Agency, the participants are the Ministry of Energy, the General Staff of the Armed Forces, the State Emergency Service, operators of critical infrastructure facilities, the State Service for Special Communications and Information Protection, regional and Kyiv city state (military) administrations, the Restoration Agency, services for the restoration and development of infrastructure in the regions, design and construction organizations (by agreement).

As part of the implementation of the experimental project, by the end of the 2023/2024 autumn-winter season, it was envisaged to establish two levels of protection — against UAVs and missiles — for 22

²⁶⁷ <https://zakon.rada.gov.ua/laws/show/1109-2020-%D0%BF>

²⁶⁸ <https://zakon.rada.gov.ua/laws/show/415-2023-%D0%BF#n15>

²⁶⁹ <https://zakon.rada.gov.ua/laws/show/1482-2022-%D0%BF#Text>

main substations of UES of Ukraine²⁷⁰. The Restoration Agency works together with Ukrenergo, which forms the design and construction tasks.

In total, the creation of three levels of protection²⁷¹ is envisaged:

1. passive protection against shrapnel (gabions and big-bags), protection of 103 facilities (73 electricity infrastructure, 30 gas infrastructure)²⁷² in 21 regions;
2. protection of autotransformers from shrapnel and drone strikes (reinforced concrete structures), protection of 63 autotransformers of 22 substations in 14 regions²⁷³;
3. experimental protection against missile strikes (reinforced concrete structures); solutions were designed and computer simulation of loads was completed; a total of 22 substations in 14 regions are to be protected.

As of March 2023, according to the information of the Head of the Restoration Agency Mustafa Nayyem²⁷⁴, the first level provided protection for 103 facilities in 21 regions, including facilities of generation and distribution networks, the second level provided protection for 22 substations in 14 regions.

At the same time, the completion of the construction of protective structures in full requires additional off-budget sources of funding.

PM_ES_WAM_07 Provision of physical, engineering, technical and cyber protection of 100% CIF of the energy sector

Goal: The Energy Security Strategy identifies among the priority tasks for achieving Strategic Goal 2. Stability of the energy sector functioning, among other things, ensuring cyber security and physical security of the critical infrastructure of the energy sector. Cybersecurity Strategy of Ukraine²⁷⁵ among the foundations of the development of the national cyber defense system indicates the achievement of cyber resilience - the ability to quickly adapt to internal and external threats in cyberspace, support and restore the sustainable functioning of the national information infrastructure, primarily critical information infrastructure objects. As of the end of 2023, the Cyber Security Strategy implementation indicators are under development.

Legal basis: ESU, Energy Security Strategy, Cybersecurity Strategy of Ukraine, Law of Ukraine "On the Basic Principles of Ensuring Cybersecurity of Ukraine", separate decisions of the National Security and Defence Council

Responsible bodies/organizations: Ministry of Energy, Administration of the State Service for Special Communications and Information Protection, Ministry of Infrastructure, National Coordination Center for Cyber Security (NSDC)

Description: Among the strategic initiatives and tasks, the ESU provides for:

- by 2025:
 - Implementation of a comprehensive approach to ensuring security (physical security, engineering security and cyber security);

²⁷⁰

<https://focus.ua/uk/economics/599528-do-kincya-zimi-u-mininfrastrukturi-nazvali-termini-vstanovlennya-zahistu-na-klyuchovi-pidstanciyi-video>

²⁷¹ <https://restoration.gov.ua/press/news/58489.html>, <https://mtu.gov.ua/news/35069.html>

²⁷² <https://interfax.com.ua/news/economic/953814.html>

²⁷³ <https://mtu.gov.ua/news/35002.html>

²⁷⁴ <https://www.facebook.com/Mustafanayyem/posts/10226536860993820>

²⁷⁵ <https://zakon.rada.gov.ua/laws/show/447/2021#n12>

- Development and approval of an effective methodology for assessing threats and the state of energy security, which would meet the challenges of reliability and safety of energy supply;
- Approval of placement of new energy facilities (large assets of state-owned companies) with representatives of the security and defense sector and determination of the responsible state authority;
- Strengthening the ability to timely identify, prevent and neutralize threats to the security of the energy infrastructure;
- Development of a comprehensive protection program for energy infrastructure facilities, which will include a safety passport;
- Implementation of comprehensive protection measures in the energy sector;
- Improvement of engineering and technical and other measures in order to prevent and/or prevent illegal actions on energy CIF;
- Ensuring revision of regulations regarding provision of CIF with an emergency reserve of the necessary equipment and facilities;
- Review of the project threat to the facilities of the nuclear-industrial complex and other CIF, taking into account the results of the full-scale invasion of the Russian Federation into Ukraine;
- Development of a program to strengthen safety measures for already existing energy infrastructure facilities;
- Ensuring the development of projects for the development of the electricity transmission system and gas networks, taking into account all physical security requirements;
- Determination of the responsible authority for engineering safety and distribution of powers regarding the implementation of engineering safety measures;
- Study of the feasibility and implementation of pilot projects for the placement of individual elements of the energy infrastructure underground, taking into account the feasibility and possibility of placement (for example, substations in a protected design).
- by 2032:
 - Development of an economically feasible proposal to change the state norms for the construction of new energy facilities, taking into account the need to adapt to climate change and minimize its impact, which will involve making changes to the regulatory acts of design, construction of electrical installations, electricity networks to ensure their physical protection;
 - Implementation of complex processes and modern technological solutions to increase the protection of energy sector systems against cyber attacks;
 - Stimulating investments in ensuring digitization and strengthening cyber security in the energy sector;
 - Implementation of measures for the Concept of the Implementation of Smart Grids in Ukraine by 2035: determination of the index, indicators and methodology for assessing the state of cyber security of electricity networks in Ukraine in accordance with international practices, in particular the use of the Cybersecurity capability maturity model program.
 - Application of solutions to ensure cyber security to the infrastructure of information and computer systems, power grids, electricity metering systems and electronic communication networks.
 - Ensuring regular assessment of the state of cyber security of electricity networks in Ukraine.

By the decision²⁷⁶ of the National Security and Defence Council of Ukraine of October 17, 2023, the Cabinet of Ministers of Ukraine is tasked with guaranteeing the performance of engineering and physical protection of critical infrastructure facilities and the fuel and energy complex, approving the Action Plan for the restoration of critical infrastructure facilities that have been destroyed or damaged as a result of Russia's aggression, developing and approving in 2023 the Energy Resilience Plan of

Ukraine with the definition of sources of financing. In turn, the Ministry of Energy, together with the Ministry of Infrastructure, the State Emergency Service, operators of critical infrastructure facilities, and local state (military) administrations must ensure engineering protection of critical infrastructure facilities and their restoration in case of damage.

Owners and/or heads of enterprises, institutions are responsible for ensuring cyber protection of communication and technological systems of the CIF, protection of technological information in accordance with the requirements of the law, for immediate notification of CERT-UA about cyber security incidents, for the organization of an independent audit of information security at such facilities and organizations assigned to CIF.

The State Service for Special Communications and Information Protection coordinates, organizes and conducts vulnerability audits of communication and technological systems of critical infrastructure facilities. The Security Service of Ukraine prevents, detects, stops and discloses criminal offenses in cyberspace, as part of the fight against cyber-terrorism and cyber-espionage, secretly checks the readiness of the CIF for possible cyber-attacks and cyber-incidents.

To a large extent, the cyber protection of CIF is related to the implementation of the requirements of the Law of Ukraine "On Critical Infrastructure" (see PM_ES_WEM_08). In particular, in December 2022, the requirements for cyber security of the fuel and energy sector of critical infrastructure were approved by the order of the Ministry of Energy of December 15, 2022, No. 417, registered in the Ministry of Justice on February 8, 2023 under No. 249/39305²⁷⁷.

The Ministry of Energy is working on the construction of a sectoral system of cyber protection of enterprises of the fuel and energy complex. The corresponding system is based on the concentration of efforts of two industry cyber centers, created on the basis of Ukrenergo and Naftogaz. It is assumed that the relevant cyber centers will become the sectoral cyber security centers for the electricity and oil and gas complex, respectively, and in the future also for the nuclear-industrial, coal-industrial, and peat-mining complexes²⁷⁸.

In addition, at the working level, the development of an industry strategy for cyber security of energy CIF and conducting an audit of the state of cyber security at such CIF were foreseen²⁷⁹. In 2024, the Ministry of Energy published a draft order "On the approval of the Methodology for assessing the state of cyber security of electricity networks and practices of cyber security of electricity networks"²⁸⁰.

The 2023-2024 action plan for the implementation of the Cybersecurity Strategy of Ukraine, approved by the order of the Cabinet of Ministers of Ukraine of December 19, 2023, No. 1163²⁸¹ (Official Gazette of Ukraine, 2024, No. 9, Article 508), provides, inter alia, for the development and approval of typical cyber security target profiles for critical infrastructure sectors. While the action plan

²⁷⁶ <https://www.president.gov.ua/documents/6952023-48641>

²⁷⁷ <https://zakon.rada.gov.ua/laws/show/z0249-23#Text>

²⁷⁸ <https://mev.gov.ua/storinka/kiberbezpeka-enerhetychnoyi-haluzi>

²⁷⁹

https://www.mev.gov.ua/sites/default/files/field/file/budget/%D0%97%D0%B2%D1%96%D1%82%20%20%D0%B1%D0%B5%D0%B7%D0%BF%D0%B5%D0%BA%D0%B0%20%D0%BF%D0%BE%D1%81%D1%82%D0%B0%D1%87%D0%B0%D0%BD%D0%BD%D1%8F_2019.docx

²⁸⁰

<https://mev.gov.ua/rehulyatornyy-akt/povidomlennya-pro-oprylyudnennya-proyektu-nakazu-ministerstva-enerhet yky-16>

²⁸¹ <https://zakon.rada.gov.ua/laws/show/1163-2023-%D1%80#Text>

for the implementation of the Concept of Ensuring the National Resilience System until 2025, approved by the order of the Cabinet of Ministers of Ukraine of November 10, 2023, No. 1025²⁸² (Official Gazette of Ukraine, 2023, No. 103, Article 6179), includes ensuring until the end of 2024 cyber protection of generation, transportation, distribution systems, etc., by creating or connecting critical information infrastructure objects to cyber incident (computer events) response centers, creating or organizing interaction with computer emergency response teams, the Security Service's Cyber Security Situation Center.

Thus, the creation of a multi-level cyber protection system involves a) the direct responsibility of CIF operators, b) the monitoring and expert role of sectoral cyber centers under the leadership of the Ministry of Energy, c) the activities of the entities of the national cyber security system (State Service for Special Communications and Information Protection, Security Service, etc.). According to the ESU, it is also planned to create a Situation Center in the energy industry, which will allow forecasting events in the sector and increase the efficiency of decision-making due to the functionality of simulating various scenarios.

PM_ES_WAM_08 Creation of backup power sources of CIF, including using distributed renewable energy generation

Goal: Ensuring the resilience of critical infrastructure to security threats, the continuity of vital services

Legal basis: Concept of the State Targeted Economic Program of energy modernization of enterprises - heat energy producers, which are in state or communal ownership, for the period until 2030²⁸³; the draft Concept of the State Targeted Economic Program for stimulating the development of distributed generation of electricity from renewable energy sources for the period up to 2030²⁸⁴; the draft of the updated edition of the State Strategy for Regional Development for 2021-2027²⁸⁵

Time frames: 2023-2030

Responsible bodies/organizations: Ministry of Energy, Ministry of Infrastructure, local self-government authorities

Description: The Concept of the State Targeted Economic Program for the energy modernization of state- or municipally-owned heat energy producing enterprises includes increasing the efficiency and reliability of district heating systems. In turn, implementation of the measures envisaged by the program will make it possible to strengthen Ukraine's energy security, improve the safety and quality of heat supply services for 5.3 million households (see also PM_EE_WAM_08).

Stimulation measures are provided in the form of support for local self-government authorities and enterprises in the field of heat supply by partially reimbursing the cost of measures provided for by the current heat supply scheme, including:

- construction and connection to the district heating system of reserve (in addition to the existing) sources of heat energy and separate heat-generating units that use energy sources other than the main ones;
- installation of backup sources of electricity at facilities in the field of heat supply in district heating systems.

²⁸²

<https://www.kmu.gov.ua/npas/pro-zatverdzhennia-planu-zakhodiv-z-realizatsii-kontseptsii-zabezpechennia-natsionalnoi-sistemy-stiikosti-do-2025-roku-i101123-1025>

²⁸³ <https://zakon.rada.gov.ua/laws/show/1093-2023-%D1%80#Text>

²⁸⁴

<https://mev.gov.ua/proyekt-normatyvno-pravovoho-aktu/povidomlennya-pro-oprylyudnennya-proyektu-rozporядzhennya-1>

²⁸⁵ <https://mtu.gov.ua/news/35001.html>

In turn, taking into account the challenges associated with the full-scale invasion of the Russian Federation into Ukraine, the Ministry of Infrastructure was provided with an update of the provisions of the State Strategy for Regional Development for 2021-2027, approved by Resolution No. 695 of the Cabinet of Ministers of Ukraine of August 5, 2020, (Official Gazette of Ukraine, 2020, No. 67, Article 2155). In particular, one of the operational goals of the mentioned strategy is "Infrastructure resistant to security, social and economic challenges", within the framework of which the following tasks are proposed under the "Energy infrastructure" direction:

- development of distributed generation of electricity in territorial communities;
- development of electricity generation from renewable sources and the use of ESS in centralized water supply and drainage systems in territorial communities.

Support for the deployment of sustainable decentralized sources of electricity supply is envisaged as part of the policy to stimulate the development of distributed electricity generation from renewable energy sources for the period up to 2030 (see PM_IME_WAM_05). In particular, it is assumed that at the first stage (2024-2026), support will be provided to enterprises of state and communal forms of ownership for RES installations with a capacity of up to 500 kW together with ESS, which will enable autonomous power supply of CIF for 4 hours²⁸⁶. Priority CIF include:

- systems of centralized water supply (pumping stations of first and second lifting, additional pressure pumping stations);
- systems of centralized drainage (sewage pumping stations, sewage treatment facilities);
- district heating systems (boiler plants, heating substations);
- healthcare facilities.

In the second stage (2027-2030), it is planned to extend support to other entities of state and communal forms of ownership (administrative buildings, educational institutions, etc.) for RES installations with ESS to cover basic needs (lighting, operation of office equipment, communications).

It is worth noting that local self-government authorities, especially at the level of large cities, have already implemented or are planning to implement projects for equipping life support facilities (in particular, boiler houses, pumping stations of water utilities), as well as public buildings (healthcare facilities, educational institutions, and administrative buildings) with backup power sources. At the same time, among the applied technologies are not only diesel generators, but also gas piston units, solar panels and hybrid systems (a combination of different sources), often with ESS.

PM_ES_WEM_09 Financial reserve for the decommissioning of nuclear installations

Goal: Providing the necessary financial resources for the timely decommissioning of NPP power units

Legal basis: Law of Ukraine "On Regulation of Issues Related to Ensuring Nuclear Safety", Resolution of the Cabinet of Ministers of Ukraine of April 27, 2006, No. 594 "Issues of Creation, Accumulation and Use of Financial Reserves for the Decommissioning of Nuclear Installations" (Official Gazette of Ukraine, 2006, No. 18, Article 1339; 2012, No. 24, Article 917; 2017, No. 36, Article 1136), Resolution of the Cabinet of Ministers of Ukraine of January 22, 2014, No. 21 "On the supervisory board for monitoring the use and investment of the funds of the financial reserve intended for the decommissioning of operating power units of nuclear power plants" (Official Gazette of Ukraine, 2014, No. 10, Article 325; 2021, No. 80, Article 5071), Resolution of the Cabinet of Ministers of Ukraine of February 21, 2023, No. 156 "On approval of the Procedure for the use of funds provided for in the state budget for the purchase of domestic state loan bonds by the Ministry of Energy in accordance with Article 9 of the Law of Ukraine "On Regulation of Issues Related to Ensuring Nuclear Safety" and recognition of certain resolutions of the Cabinet of Ministers of Ukraine as invalid" (Official Gazette of Ukraine, 2023, No. 25, Art. 1410), order of the Ministry of Energy and Coal Industry of Ukraine of December 10, 2015, No. 798 "On approval of the Concept of decommissioning of operating nuclear power plants of Ukraine"

Time frame: since 2005

Responsible bodies/organizations: Ministry of Energy, JSC NAEK Energoatom, State Nuclear Regulatory Inspectorate of Ukraine

Description: According to the ESU, for the period until 2030, it is planned to extend the service life of the existing NPP power units based on the results of their safety reassessment. Termination of operation and preparation for decommissioning of power units that have exhausted their lifetime is planned on the horizon until 2050.

The main document, on the basis of which preparation for the decommissioning of nuclear power plants is carried out, is the Concept of Decommissioning of Existing Nuclear Power Plants of Ukraine. According to the results of the comparative analysis, the Concept concludes that the most acceptable option is the delayed dismantling with an initial storage period of 30 years. Taking into account the fact that the Concept is subject to revision every 6 years, its update in order to review the cost estimation for decommissioning NPP power units must be provided within the capabilities of the Ministry of Energy to conduct scientific research and scientific and technical developments.

In accordance with the Law "On Regulation of Issues Related to Ensuring Nuclear Safety", Energoatom JSC as an operating organization (operator) deducts funds to a special account of the Treasury for the formation of a financial reserve. Funds from the financial reserve are used exclusively for financing the development of the nuclear installation decommissioning project, measures related to the termination of operation and decommissioning of the nuclear installation, which are provided for by this project, and for investing in domestic government bonds in order to protect against inflation and obtain additional source of its formation.

The amount of deductions is provided for by the Concept of decommissioning the operating nuclear power plants of Ukraine, and the mechanism for establishing this amount is defined in a separate Procedure (approved by Resolution No. 594 of the Cabinet of Ministers of Ukraine of April 27, 2006). After approval of the decommissioning project, the amount of deductions is revised taking into account ensuring the necessary amount of expenses.

The investment policy is determined by the Procedure for the use of funds provided in the state budget for the Ministry of Energy's purchase of domestic government bonds in accordance with Article 9 of the Law of Ukraine "On Regulation of Issues Related to Ensuring Nuclear Safety". This Procedure provides for the Ministry of Energy's acquisition of government bonds issued by the Ministry of Finance with a maturity of one to five years (medium-term bonds) and more than five years (long-term bonds).

Control over the use and investment of the funds of the financial reserve is carried out by a seven-person supervisory board, which functions in accordance with a separate procedure. The supervisory board is formed by representatives of the Ministry of Finance, the Ministry of Economy, the Ministry of Energy, the State Nuclear Regulatory Inspectorate, the operating organization (operator), as well as with the consent of representatives of the NEURC and the National Securities and Stock Market Commission. Every year by March 25, it reports to the Cabinet of Ministers of Ukraine and submits recommendations on improving the use of the financial reserve.

PM_ES_WEM_10 Management of spent nuclear fuel (SNF) and radioactive waste (RAW)

Goal: Ensuring safe storage and disposal of spent nuclear fuel and radioactive waste

Legal basis: the Law of Ukraine "On the Use of Nuclear Energy and Radiation Safety", the Law of Ukraine "On the Management of Radioactive Waste", the Law of Ukraine "On the Management of Spent Nuclear Fuel on the Placement, Design and Construction of a Centralized Storage Facility for Spent Nuclear Fuel of VVER Type Reactors of Domestic Nuclear Power Plants", Resolution of the Cabinet of Ministers of Ukraine of April 29, 1996, No. 480 "Some issues of handling radioactive waste" as amended by resolutions of the Cabinet of Ministers of Ukraine of April 8, 2009, No. 323 (Official Gazette of Ukraine, 2009, No. 26, Art. 872) and of August 22, 2012, No. 788 (Official Gazette of Ukraine, 2012, No. 64, Art. 2620), Order of the Cabinet of Ministers of Ukraine of August 19, 2009, No. 990-r "On approval of the Radioactive Waste Management Strategy in Ukraine" (Official Gazette of Ukraine, 2009, No. 65, Art. 2275), Resolution of the Cabinet of Ministers of Ukraine of April 25, 2018, No. 330 "On Approval of the Procedure for Using Funds of the State Fund for Radioactive Waste Management" (Official Gazette of Ukraine, 2018, No. 37, Art. 1310), Resolution of the Cabinet of Ministers of Ukraine of August 11, 2021, No. 847 "On Approval of the State Economic Program for the Management of Spent Nuclear Fuel of Domestic Nuclear Power Plants for the Period

Until 2025" (Official Gazette of Ukraine, 2021, No. 66, Article 4190), Order of the Cabinet of Ministers of Ukraine of November 4, 2022, No. 992-r "On the approval of the Concept of the State-Wide Targeted Environmental Program for the Management of Radioactive Waste"

Responsible bodies/organizations: Ministry of Energy, State Agency for the Exclusion Zone Management (SAEZM), JSC NAEK Energoatom, SSP Radon Association, SSP Central Enterprise for Radioactive Waste Management (SSP CEMRW), State Nuclear Regulatory Inspectorate

Description: As for spent nuclear fuel, Ukraine has chosen the path of long-term safe storage in intermediate storage facilities. A decision on further processing or disposal is expected to be made before the end of the operational life of such storage facilities. The State Economic Program for the Management of Spent Nuclear Fuel of Domestic Nuclear Power Plants for the Period Until 2025 determines that after unloading of spent nuclear fuel from storage pools, the following actions are carried out by the operating organization (operator):

- SNF of the VVER-1000 type reactors of the Zaporizhzhia NPP is stored in a dry on-site storage facility;
- SNF of the VVER-440 type reactors of the Rivne NPP and the VVER-1000 type reactors of the Rivne, Khmelnytskyi and South Ukraine NPPs are subject to removal for long-term storage (100 years) to the Centralized Spent Nuclear Fuel Storage Facility (CSNFSF).

Funding of the Program's activities is carried out at the expense of own and credit (loan) funds raised by Energoatom, as well as other sources of funding not prohibited by law. The Program also provides for the development of a long-term Concept for management of spent nuclear fuel of Ukrainian nuclear power plants, which will determine the strategic directions of the specified activity for the period up to 2035 and beyond.

Thus, the following are currently operating in Ukraine: a wet type storage facility at the Chornobyl NPP site (SNFSF-1), a dry type storage facility at the Chornobyl NPP site (SNFSF-2), a dry on-site storage facility at the Zaporizhzhia NPP, and the CSNFSF. The creation of the latter allowed Ukraine to finally get rid of dependence on the Russian Federation in the matter of SNF storage. Current work on putting it into operation is being carried out by Energoatom in accordance with the terms of the permit documents received from the State Nuclear Regulatory Inspectorate in accordance with the established procedure. From 2023, the direct delivery of spent nuclear fuel to the CSNFSF site began. The design life of the CSNFSF is 100 years.

In accordance with the provisions of the ESU and the Strategy for Radioactive Waste Management in Ukraine, the safe handling of radioactive waste is one of the most important factors for the sustainable development of the nuclear energy industry in Ukraine, as well as the use of radiation-nuclear technologies in medicine, science and industry. In order to ensure an integrated process of RAW management in Ukraine, facilities designed for RAW management must be created in sufficient quantity and operate safely, taking into account all sources, volumes and characteristics of waste.

The priority tasks and measures to create a comprehensive system of RAW management are defined in the Strategy for Radioactive Waste Management in Ukraine, approved by the Order of the Cabinet of Ministers of Ukraine No. 990 of August 19, 2009, in the National Targeted Environmental Program for the Management of Radioactive Waste, approved by the Law of Ukraine of September 17, 2008, No. 516-VI, and in the Concept of the State-Wide Targeted Environmental Program for the Management of Radioactive Waste, approved by the Order of the Cabinet of Ministers of Ukraine of November 4, 2022, No. 992.

The Law of Ukraine "On the Management of Radioactive Waste" specifies that the financing of works related to RAW management is carried out at the expense of the State Fund for the Management of RAW. The manager of the funds is SAEZM, the funds themselves are directed to the implementation of programs and the execution of works, determined in accordance with the Procedure for the use of funds of the State Fund for the Management of RAW.

Also, in accordance with the Law of Ukraine "On the Management of Radioactive Waste", State accounting of radioactive waste is ensured, including maintenance of the State Register of radioactive waste and maintenance of the State Cadastre of radioactive waste storage facilities and the list of places of temporary storage of radioactive waste. State inventories are carried out once every three years to ensure constant renewal and timely changes to the State Register of RAW and the State

Cadastre of RAW storage facilities. The functions of maintaining the State Register and Cadastre are assigned to SSP Radon Association.

At the same time, the Concept of the National Targeted Environmental Program for the Management of Radioactive Waste foresees a number of measures aimed at solving complex problems in the specified area, creating and ensuring the effective functioning of an integrated system of RAW management in Ukraine. The implementation of the program is expected during 2022-2031, among the ways and means of solving the problem of RAW management, it is worth highlighting:

- improvement of the legal framework taking into account Council Directive 2011/70/Euratom on the introduction of a framework for responsible and safe management of spent fuel and radioactive waste and Council Directive 2013/59/Euratom on establishing basic safety standards for protection against threats caused by exposure to ionizing radiation;
- development and implementation of a quality management system at all stages of RAW management, improvement of the RAW generation control system;
- carrying out a reassessment and update of the justification for the safety of the storage facilities of SSP CEMRW;
- reconstruction of the existing storage facilities of CEMRW for RAW disposal;
- technical re-equipment (in particular, modernization of the physical protection system) of the SSP Radon Association and CEMRW facilities;
- improvement and implementation of the RAW management system at NPPs, in particular, minimization of the volume of their generation;
- continuation of operation and development of the first stage of the Vector complex, acceptance of conditioned RAW from operating nuclear power plants of Ukraine to the existing storage facilities of the Vector complex's first stage;
- design and construction of the second stage of the Vektor complex;
- carrying out a complex of works with the aim of selecting sites potentially suitable for placing RAW storage at medium depths and geological RAW storage, as well as research works on choosing the optimal system of engineering barriers for such storage.

Policies and measures to **increase the flexibility of the national energy system** are the subject of a multi-level regulatory system - from strategic to specific mechanisms.

Inter alia, the Energy Security Strategy provides among the priority tasks

- on the achievement of Strategic Goal 2 "Sustainability of the functioning of the energy sector":
 - ensuring the balanced development of energy supply systems, taking into account the unevenness of the consumption schedule and the work of individual energy producers;
 - adaptation of the energy sector to the negative impact of climate change;

²⁸⁶ <https://mev.gov.ua/sites/default/files/field/file/prezentaciya.pdf>

- on the achievement of Strategic Goal 3 "Economic efficiency of the functioning of the energy sector, energy supply systems and import substitution of mineral raw materials":
 - modernization of fixed assets in the energy sector, in particular by creating favorable conditions for the introduction of mechanisms to support the implementation of large-scale investment projects for the development of critical infrastructure in the energy sector;
- on the achievement of Strategic Goal 4 "Energy efficiency of the use of energy resources and energy efficiency of the national economy":
 - implementation of a set of measures to expand the use of local alternative fuels;
 - development of a set of measures for the integration of consumers using RES for their own consumption into the operation of the UES of Ukraine.

The 2030 National Economic Strategy is limited to the task of "ensuring guaranteed adequacy of generating capacities with the volumes and regimes of electricity consumption in the UES of Ukraine, in particular in terms of the availability of regulatory capacities".

The 2050 Energy Strategy of Ukraine provides greater clarity in the setting of targets for the development of highly flexible generation, ESS and demand management systems, among strategic initiatives and tasks:

- by 2025:
 - Development of distributed generation using natural gas, by installing gas turbines and gas piston turbines at the sites of the gas transmission system, CHPs and boiler plants;
 - Development of RES, which includes a set of measures for the construction of ESS, wind generation and promoting the development of distributed solar generation to cover own consumption;
 - Installation of wind/solar systems and ESS for critical infrastructure facilities and private households;
 - Active implementation of energy storage technologies with further expansion of their use in the following time horizons;
 - Studying the feasibility of creating microgrids and decentralized power supply to ensure the stability of the energy system;
 - Studying the feasibility of creating a demand management program.
- By 2032:
 - Decentralization of the energy system by increasing the number of energy generation facilities while simultaneously reducing spatial disparities in their localization, which will contribute to increasing the overall reliability of the functioning of energy systems and reducing their vulnerability to threats of a physical and virtual nature.
 - Implementation of pilot projects for the creation of microgrids and decentralized power supply to ensure the stability of the energy system.
 - Implementation of pilot projects on the creation of a demand management program.
 - Support for the implementation of energy storage technologies.

Among the practical tools, which should be highlighted:

- **participation in the balancing market and the market of auxiliary services** on a general basis;
- **tenders for the construction of generating capacity and implementation of demand management measures;**
- provision of balancing services and auxiliary services **by aggregators and active consumers using the mechanism of self-production.**

For more details, see section 3.4.3. of this Plan, Market Integration (Dimension internal energy market).

ii. Regional cooperation in this area

The current rules of preparation and response to crisis situations in the supply of natural gas or electricity provide for a mechanism for constant exchange of information between Ukraine, on the one hand, and the Energy Community Secretariat (in particular, the Security of Supply Coordination Group) and competent authorities of neighboring EU member states. At the same time, the development of gas and petroleum products supply routes requires active cooperation between Ukraine and the states of Central-Eastern and South-Eastern Europe, in particular Poland, Slovakia, Hungary, Romania, Bulgaria, as well as the Baltic states.

The Energy Community Secretariat and the governments of neighboring EU member states play a critical role in the mechanism of supplying equipment to energy companies of Ukraine affected by the consequences of hostilities. In particular, the Energy Community Secretariat together with the European Commission, the EU Emergency Response Coordination Center and the Ukrainian authorities ensures the delivery of energy carriers and goods - both provided free of charge and purchased with the funds of the Ukraine Energy Support Fund administered by it²⁸⁷; equipment purchases are carried out according to international standards of transparency by the United States Agency for International Development (USAID).

Ukraine's implementation of the Clean Energy Package provides for market coupling and strengthening of mutual energy security based on the principle of solidarity. In particular, the Ukrainian TSO should use the opportunities of full membership in the ENTSO-E and join the activities of the Regional Coordination Center (RCC) to participate in seasonal and short-term assessments of resources adequacy. The implementation of the Regulation (EU) 2019/941 on preparedness for risks in electricity and the Regulation (EU) 2017/1938 on measures to guarantee the security of gas supply provide for the strengthening of regional cooperation - in particular, Ukraine can participate in the work of the relevant coordination groups of the EU (Electricity Coordination Group, Gas Coordination Group), as well as cooperate with the EU member states and the Contracting Parties of the Energy Community in the process of risk assessment and preparation of relevant plans (consultations to ensure consistency).

The integration of gas systems and markets with the participation of GTSOU LLC, JSC Ukrtransgaz and other market entities is a subject of cooperation within the framework of initiatives such as CESEC (Central and South Eastern Europe Gas Connectivity Initiative) and SEEGAS (South-East European Gas Initiative). Ukrainian companies also participate in the joint EU gas procurement platform AggregateEU.

Cooperation with the governments and operators of neighboring states in the process of identification and implementation of projects of mutual interest (PMIs) and projects of common interest within the framework of the Energy Community (PECI) is also promising. See more details in section 3.4. Dimension internal energy market.

²⁸⁷ <https://www.energy-community.org/Ukraine/Fund.html>

Regional cooperation is also envisaged when Ukraine creates minimum stocks of crude oil and petroleum products. The Law of Ukraine on the minimum stocks of crude oil and petroleum products contains provisions, according to which, during the period of martial law, part of the stocks can be stored abroad in EU member states bordering Ukraine (no more than 50% of the total volume) and EU countries bordering such states (no more than 25% of the total volume). Beyond the state of war, it is possible to store in EU member states bordering Ukraine no more than 25% of the total volume of minimum stocks, if the central storage agent or economic entity has free tanks at its disposal.

In May 2023, Ukraine officially joined the NATO Cooperative Cyber Defence Centre of Excellence (CCDCOE), which supports combating cyber attacks and cyber defense of information systems, as well as education and training of cyber defense specialists²⁸⁸. Ukraine's participation in the activity of CCDCOE will strengthen the exchange of cyber experience with other participating countries, in particular in matters of protection of CIF in energy.

An important platform for political dialogue and technical cooperation on energy security issues is the Partnership for Transatlantic Energy and Climate Cooperation (P-TECC) with the participation of Ukraine, the U.S., the EU and 24 European countries²⁸⁹.

iii. Where applicable, financing measures in this area at national level

The vast majority of the necessary financing is made up of investments made by energy market players - extractive companies, TSO and GTSO, DSOs and GDSOs, traders and suppliers (in particular, in terms of creating minimum reserves of crude oil and petroleum products), operators of oil refining facilities, generating companies, etc. At the same time, a form of state aid is the creation of favorable tax and regulatory conditions, in particular for companies in the extractive sector.

Funding from the state budget is provided for part of the activities of the experimental project on construction, repair and other engineering and technical measures for the protection of key CIF. In particular, according to the Ministry of Finance, during 2023-2024, 18,465.9 million UAH were allocated to the Reconstruction Agency from the State Budget of Ukraine (of which cash expenditures in 2023 - 13,955.6 million UAH, planned expenditures for 2024 - 4,510.3 UAH million) for the implementation of protection measures at 22 substations of Ukrenergo. In addition, Ukrenergo carries out measures to ensure protection at other 63 substations at the expense of international financial organizations, in particular by repurposing a part of loan and grant funds within the framework of current joint projects with the IBRD, EIB, EBRD, KfW. The implementation of a full-fledged set of measures to protect these facilities requires the involvement of additional non-budgetary sources of funding.

With regard to the financing of future state targeted economic programs for the development of the nuclear-industrial complex and the development of distributed generation of electricity from renewable sources, paragraph 12 of the Measures on the effective and rational use of state funds provided for the maintenance of state authorities and other state institutions, and enterprises, institutions and organizations established by state authorities that use the funds of the state budget, approved by the resolution of the Cabinet of Ministers of Ukraine of October 11, 2016, No. 710 (Official Gazette of Ukraine, 2016, No. 83, Article 2739)²⁹⁰, it is provided for the suspension of the preparation of new targeted economic programs or making changes to approved targeted programs that require additional funding from the state budget. Therefore, implementation of the specified programs can be carried out at the expense of investments, international aid and other sources not prohibited by law.

²⁸⁸ http://twitter.com/MFA_Ukraine/status/1658432462689652738

²⁸⁹ <https://www.energy.gov/ia/partnership-transatlantic-energy-and-climate-cooperation-p-tecc>

²⁹⁰ <https://zakon.rada.gov.ua/laws/show/710-2016-%D0%BF#Text>

A significant amount of technical assistance, including for preparing bankable projects and improving the quality of public administration, can be obtained through participation in the EU programs - the Horizon Europe research and innovation program, the Euratom Research and Training Programme (2021-2025), Connecting Europe Facility (CEF), Digital Europe Programme, LIFE. A separate direction will be financing opportunities within the Ukraine Facility, which is designed for 2024-2027. Also, according to business estimates, the creation of minimum reserves of crude oil and petroleum products will require support from technical assistance projects based on the experience of one of the leading EU countries.

3.4. Dimension internal energy market

3.4.1. Electricity infrastructure

i. Policies and measures to achieve the targeted level of interconnectivity as set out in point (d) of Article 4

Planning of interconnectors development

The development of interconnections with neighboring countries is ensured within the framework of the 10 years transmission system development plan (TSDP), which is developed annually by the transmission system operator in accordance with the procedure approved by the Regulator and submitted to the Regulator for approval. The TSDP should ensure the compliance of the transmission system with the needs of the market and the interests of security of electricity supply. TSDP, in particular, includes:

- the main objects of the transmission system, the construction or reconstruction of which is expedient within the next 10 years, including projects for the development of interconnectors;
- information about the objects of the transmission system that are to be built and/or reconstructed within the next 10 years, the terms of their construction and/or reconstruction, sources of financing;
- information about investments in transmission system elements, regarding which decisions have already been made and which are at the stage of implementation, with an indication of forecast investments to be made within the next three years.

TSO develops TSDP on the basis of the Generation capacity adequacy assessment report, as well as plans for the development of adjacent transmission systems, electricity distribution systems. Also, the TSO develops an annual investment program and submits it to the Regulator together with the calculation of the tariff for electricity transmission services.

Simplification of administrative procedures and attraction of investments in infrastructure projects of mutual interest is ensured through the implementation of policy **PM_IM_WAM_01 Promotion of development of new interstate connections / crossings** (see p. 3.4.2.i).

ii. Regional cooperation in this area

In 2017, NEC Ukrenergo signed the Agreement on the conditions for the future integration of the energy system of Ukraine with the energy system of continental Europe, which provided for the implementation of a catalog of preparation and testing measures in the form of a 3-day isolation from the energy systems of the Russian Federation and the Republic of Belarus. Since March 16, 2022, the Unified Energy System (UES) of Ukraine has been urgently integrated and operates in synchronous mode with the energy system of Continental Europe within the framework of the European Network of Transmission System Operators in Electricity (ENTSO-E). In 2022-2023, TSO of Ukraine completed the implementation of the Catalog of measures, which is part of the Agreement on the conditions for the future integration of the energy systems of Ukraine and continental Europe. The catalog contains over 200 technical measures in 9 areas. All these measures are an integral part of the Framework Agreement on the Synchronous Area of Continental Europe (SAFA), to which NEC Ukrenergo also joins. On November 28, 2023, the ENTSO-E Regional Group "Continental Europe" confirmed the full implementation of the Catalog of Activities by NEC Ukrenergo, which means the completion of the synchronization project between the UES and the European continental network.²⁹¹

Until December 2023, NEC Ukrenergo was an observer member of ENTSO-E and ensured the technical compliance of Ukraine's UES with ENTSO-E standards and requirements. On December 14, the ENTSO-E Assembly approved the acquisition by Ukrainian TSO of the full membership in the

organization from January 1, 2024.²⁹² The status of a member of ENTSO-E provides the TSO with opportunities to deepen regional cooperation:

- in the preparation of proposals and approval of the annual work program of ENTSO-E, which determines priorities regarding key issues of the operation of the electricity market, development of the trans-European energy infrastructure, risk management in energy;
- upon adoption of the 10-year European network development plan and strategy regarding events that significantly affect the technical, security, market or financial conditions of operation of the TSO of Europe;
- in the preparation of recommendations for the ENTSO-E Assembly regarding strategic priorities of TSO cooperation and key decisions;
- participate in the work of Committees and working groups (Committees on market issues, network development, research, development and innovation, information and communication technologies), in the development of network codes, regional investment plans and work in a group on legal and regulatory issues.

TSO of Ukraine carries out bilateral and multilateral communication and cooperation with TSO of neighboring countries in terms of increasing cross-border transmission capacity and developing interconnectors. Also TSO organizes cooperation in accordance with the Plan of interaction of NEC Ukrenergo with stakeholders within the framework of reconstruction/construction projects.²⁹³

In order to develop regional cooperation, in the future there will be cooperation between the TSO of Ukraine and the TSO of other countries of the region in the format of interaction with the regional coordination center (RCC) provided for by Regulation (EU) 2019/943 on the internal electricity market. Interaction will be carried out within the framework of the functionality defined by Annex I to this Regulation,²⁹⁴ in particular, in terms of the creation of a regional network model, coordinated calculation of regimes and determination of corrective actions in the region, determination of the capacity of interconnectors for allocation, etc.

iii. Where applicable, financing measures in this area at national level

Revenues that the TSO receives from the auctions for the interconnectors' capacity allocation are used for the purposes of guaranteeing the availability of allocated capacity, maintenance and increasing capacity by investing in the transmission system, in particular, in the construction of new cross-border transmission lines.²⁹⁵

To develop the transmission system and finance projects, TSO cooperates with leading international financial institutions (IFI), including the World Bank, the European Bank for Reconstruction and Development, the European Investment Bank, and the Credit Institution for Reconstruction (KfW).

²⁹¹ <https://www.entsoe.eu/news/2023/11/28/continental-european-tsos-announce-completion-of-synchronisation-project-with-ukrenergo-and-significant-increase-in-export-capacity-from-continental-europe-to-ukraine/>

²⁹² <https://www.entsoe.eu/news/2023/12/14/ukrainian-transmission-system-operator-npc-ukrenergo-joins-entso-e-as-new-member/>

²⁹³ https://ua.energy/wp-content/uploads/2023/08/Plan_vzayemodiyi_NEK.pdf

²⁹⁴ <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02019R0943-20220623#M1-1>

²⁹⁵ Temporarily, in connection with the introduction of martial law in Ukraine, the funds received by TSO from the distribution of the capacity of interconnectors, in addition to revenues from the management of restrictions, in the period from January 1, 2023 to December 31, 2023, are used for the following purposes: 10 % – to guarantee the actual availability of allocated bandwidth, maintenance and increase of bandwidth by making investments in the transmission system, repayment of debts under agreements on access to bandwidth of the interstate crossing; 45% – for the repayment of TSO debt, which was formed on the balancing market; 45% – for the repayment of the TSO's debt to the guaranteed buyer for the services provided to ensure an increase in the share of electricity production from alternative sources.

Loans are provided by IFIs under state guarantees for 15-20 or more years with low interest rates compared to the terms of lending by Ukrainian commercial banks and the cost of other financial instruments. The loan portfolio from IFIs is about 1.7 billion euros. The most large-scale investment projects are financed, which ensure the improvement of the reliability of electricity supply to industrial consumers and households, the national energy security, the development of the national economy, and also have a social and environmental focus.²⁹⁶

It is also expected that Ukraine will participate and attract funds for the implementation of projects for the development of cross-border electricity infrastructure within the framework of the EU program Connecting Europe Facility. The relevant agreement between Ukraine and the EU was ratified by the Verkhovna Rada of Ukraine in November 2023.²⁹⁷

3.4.2. Energy transmission infrastructure

i. Policies and measures related to the elements set out in point 2.4.2, including, where applicable, specific measures to enable the delivery of Projects of Energy Community Interest (PECI), Projects of Mutual Interest and other key infrastructure projects

PM_IM_WAM_01 Development mechanisms of new interconnectors

Goal: promoting the creation of new or increasing the existing physical capacity of interconnectors, in particular at the expense of private investors, by means of establishing mechanisms for stimulating cross-border investments.

Legal basis: Regulation (EU) 2022/869 on guidelines for trans-European energy infrastructure, Regulation (EU) 2019/942 on the establishment of the European Union Agency for Regulatory Cooperation in the Energy Sector, Law of Ukraine "On the Natural Gas Market", Law of Ukraine "On the Electricity Market"

Time frames: 2024-2025

Responsible bodies/organizations: Ministry of Energy, NEURC

Description: Stimulation of investments, in particular private ones, in new interconnections for natural gas and electricity requires the establishment of mechanisms for supporting such investments operating in the EU. Such mechanisms are:

- Creation of a coordinated and transparent procedure for obtaining the necessary permits for the implementation of cross-border projects, empowering regulatory bodies to make decisions on cross-border cost-sharing, as provided by Regulation (EU) 2022/869 on guidelines for trans-European energy infrastructure (TEN-E);
- Creation of a separate regulatory regime for the most necessary, but at the same time risky projects, as provided for in Article 54 of the Law of Ukraine "On the Natural Gas Market" and Article 24 of the Law of Ukraine "On the Electricity Market";
- Coordination of decision-making by different authorities through the powers of the EU Agency for the Cooperation of Energy Regulators (ACER), as provided for in Regulation (EU) 2019/942 on the establishment of the European Union Agency for the Cooperation of Energy Regulators.

²⁹⁶ <https://ua.energy/yevrointegratsiya/spivrobotnytstvo-z-mfo/>

²⁹⁷ <https://itd.rada.gov.ua/billInfo/Bills/Card/43091>

A draft Law of Ukraine was developed to implement the previous version of Regulation 2022/869 "On projects of national interest in the field of energy" (reg. No. 9138 of March 22, 2023), which is under consideration by the Verkhovna Rada of Ukraine.²⁹⁸ This draft law provides for the introduction of a transparent procedure for implementing projects of national interest in the field of energy, in particular, determining the procedure and criteria for selecting projects; creation of an interagency commission to ensure the implementation of projects; preparation of the project implementation plan and the schedule for obtaining a comprehensive decision in order to comply with project implementation deadlines (3.5 years); determining the possibility and order of cross-border distribution of investment costs for projects of common interest of the Energy Community between countries with the most positive impact from project implementation; stimulation of projects; development of a manual of procedures for the implementation of projects in order to increase their attractiveness for investors. At the same time, this draft needs to be coordinated with the latest version of Regulation 2022/869, as well as with the requirements for receiving funding from the Connecting Europe Facility access to which was recently opened for Ukraine.

Article 36 of Directive 2009/73/EC and Article 63 of Regulation (EC) 2019/943 provide for the possibility, based on the regulator's decision, of creating a separate regulatory regime (providing exceptions from the general regulatory regime) for operators of new cross-border infrastructure facilities. These provisions are implemented in the legislation of Ukraine, i.e. Article 54 of the Law of Ukraine "On the Natural Gas Market" and Article 24 of the Law of Ukraine "On the Electricity Market". At the same time, the implementation of cross-border projects based on these provisions of the legislation of Ukraine, taking into account the need to create a unified legal regime in several countries, requires, firstly, the verification of these provisions for full compliance with the requirements of EU legislation and, secondly, the development and adoption of additional legal acts.

Regulation 2019/942 on the establishment of ACER, implemented in the Energy Community, provides for the expansion of ACER's powers on cross-border issues with the participation of at least one Contracting Party of the Energy Community and one EU Member State, which is important for the implementation of cross-border projects. A condition for the expansion of ACER's powers is the implementation of Regulation 2019/942 and notification of this to the Energy Community Secretariat. The relevant powers of ACER concern both the electricity market and the natural gas market. The draft law of Ukraine for the implementation of this Regulation²⁹⁹ developed by the NEURC only relates to amendments to the Law of Ukraine "On the Electricity Market".

During 2025-2026, work should be carried out to bring Ukrainian legislation into full compliance with the EU requirements, with the possible involvement of international technical assistance and in consultations with EU institutions and potential investors.

PM_IM_WEM_01 Current procedures for energy infrastructure development planning

Goal: development of the energy infrastructure taking into account the goals of NECP, as well as the principle "energy efficiency first"

Legal basis: Law of Ukraine "On the Natural Gas Market", Law of Ukraine "On the Electricity Market", GTS Code, Electricity Transmission System Code

Time frame: 2024-2030 (permanent)

Responsible bodies/organizations: GTSO, TSO, NEURC

Description: The Law of Ukraine "On the Natural Gas Market" and the Law of Ukraine "On the Electricity Market" provide for the development by GTSO, electricity TSO, GDSO, electricity DSOs and other operators of

²⁹⁸ <https://itd.rada.gov.ua/billInfo/Bills/Card/41623>

²⁹⁹ <https://www.nerc.gov.ua/news/oprilyudnyuyetsya-proyekt-zakonu-ukrayini-pro-vnesennya-zmin-do-deyakih-zakoniv-ukrayini-shchodo-transponuvannya-aktiv-energetichnogo-spivtovaristva>

energy infrastructure facilities of development plans for these facilities and their approval and monitoring of implementation by the Regulator. In addition, the electricity TSO develops, and the Regulator approves, a Generation capacity adequacy assessment report to cover the forecasted demand for electricity and ensure the necessary reserves. The respective plans are prepared annually by the operators and approved by the NEURC.

In addition, in accordance with the GTS Code, immediately after the start of the annual capacity allocation auction in every odd year, GTSO cooperates with relevant adjacent GTS operators of other countries in the process of assessing market demand for capacity increase and conducting technical studies of projects of new (increased) capacity for IPs. The first assessment of market demand was carried out in 2021. The second assessment of market demand was carried out in 2023.

PM_IM_WAM_02 Additional procedures for energy infrastructure development planning

Goal: development of energy infrastructure taking into account the goals of NECP, as well as taking into account the principle of "energy efficiency first"

Legal basis: Law of Ukraine "On Energy Efficiency", amendments to Directive 2009/73/EU and Regulation (EU) No. 715/2009

Time frame: 2024-2030 (permanent)

Responsible bodies/organizations: NEURC, Ministry of Energy, Ministry of Infrastructure, GTSO, TSO

Description: In view of the latest draft amendments to Directive 2009/73/EC and Regulation (EC) 715/2009, which the EU has to approve in 2024, during 2024-2029, measures should be taken to improve energy infrastructure planning procedures:

- taking into account the principle of "energy efficiency first", recognized by the ESU, in energy infrastructure planning procedures. According to this principle, plans to expand the physical capacity of natural gas must comply with this principle, which, in particular, provides for the priority of investments in energy efficiency and reducing consumption, rather than in the construction of new infrastructure for the delivery of energy and energy resources. At the same time, the corresponding risks for other goals of NECP (in particular, energy security) should be analyzed;
- creation of plans for the development of infrastructure for the transportation of oil and oil products, as well as hydrogen;
- mutual coordination of planning processes in the electricity, gas, oil, and hydrogen markets;
- ensuring the coordination of plans for the development of energy infrastructure with plans for the development of territories and territorial communities, in particular, plans for the development of heat supply and recovery systems;
- ensuring connection of energy infrastructure development plans with property policies of relevant state companies.

PM_IMG_WAM_01 Creation of a regulatory framework for the formation of future markets and the construction of their infrastructure

Goal: development of a legal framework sufficient for the development of hydrogen and carbon dioxide (CO₂) markets and infrastructure

Legal basis: ESU

Time frames: 2024-2025

Responsible bodies/organizations: Ministry of Energy, NEURC, other stakeholders

Description: ESU, as well as the draft Hydrogen Strategy of Ukraine for the period until 2050, defines the task of creating legal, economic and organizational foundations for the functioning of hydrogen energy in Ukraine. Given the strategic course towards integration with the EU, it is logical that this process should follow the practice at the level of the EU and the EU Member States with the most developed technologies and/or markets for hydrogen and CO₂.

As of 2024 in Ukraine at the legislative level:

- no definition of hydrogen, its possible compounds (LOHC) and its environmental characteristics (renewable, low-carbon), no definition of CO₂ as a substance that can be transported through pipelines and stored in underground gas storages:

The Law of Ukraine "On Alternative Fuels" contains a definition of "biohydrogen", which, however, does not cover hydrogen produced by electrolysis, which is expected to be the main method of hydrogen production;

- there are no authorities of state authorities regarding the formation and implementation of policy in this area, as well as regarding the regulation of relations between subjects of the future market:

The Law of Ukraine "On the Natural Gas Market" regulates relations in the natural gas market. Part one of Article 19 of this Law stipulates that the provisions of this Law on natural gas are applied on a non-discriminatory basis to biogas or other types of gas from alternative sources, in the event that biogas or other gas from alternative sources meets the requirements for access to gas transportation and gas distribution systems, gas storages, LNG installations. Considering the different physico-chemical parameters of hydrogen and CO₂, this provision cannot be applied to expand the powers of state authorities on hydrogen, considering the requirements of Article 19 of the Constitution of Ukraine. Moreover, it would be inadequate, given the different level of development of the markets. This concerns the powers of both the Regulator (NEURC), and the Ministry of Energy in terms of technical rules and security of supply on the natural gas market.

The Law of Ukraine "On the NEURC" lists the spheres within which the NEURC exercises its powers, and among which there is no hydrogen. This means that the NEURC cannot implement its supervisory functions regarding projects and proposals related to hydrogen and CO₂ (for example, to include the relevant project in the 10-year development plan of GTS/UGS or to grant the right to use the tariff revenue of GTSO/GSSO for these purposes) .

- the duties and powers of operators of the future hydrogen infrastructure are missing:

Today, the most active role in the development of the hydrogen infrastructure is played by "GTS Operator GTS of Ukraine" LLC, which is a GTS operator certified according to the ISO model. JSC "Ukrtransgaz" (GSSO) conducts separate studies on readiness to accept hydrogen. At the same time, the law does not define the tasks, rights and obligations of operators of hydrogen transportation, storage and distribution systems.

- conditions for the elimination of double counting of electricity from renewable sources, which is used for the production of hydrogen.

In this regard, during 2024-2025, with the involvement of international technical assistance, a legal framework for the functioning of the hydrogen and CO₂ markets will be developed, taking into account the approaches that will be finally adopted in the changes to EU gas law, namely in the following main aspects:

- providing the necessary legal definitions;
- legislative extension of powers of state authorities to relations in the field of hydrogen and CO₂;
- legislating the basic structure of the market for hydrogen and, where appropriate, CO₂, as well as safeguards against double counting of energy.

PM_IMG_WAM_02 Creation of legal conditions for optimization of oil and gas infrastructure

Goal: elimination of legal obstacles for optimization of oil and gas infrastructure taking into account the goals of NECP

Legal basis : ESU

Time frame : 2024-2025

Responsible bodies/organizations: Ministry of Energy

Description: The draft Law of Ukraine "On Amendments to the Law of Ukraine "On Oil and Gas" Regarding the Determination of Critical Gas Storage and Critical Main Gas Transportation Pipelines" is being prepared for the second reading in the Verkhovna Rada of Ukraine (Register No. 6133 of October 5, 2021)³⁰⁰, which should allow the relevant work to be carried out by some operators and authorities. The need to adopt the draft law, as well as to create a regulatory framework based on it (a resolution of the Cabinet of Ministers of Ukraine, other state property management bodies) is emphasized by the subjects of the natural gas market as it is a prerequisite for both oil and gas infrastructure optimization projects and opportunities expanding the activities of its operators to other types of gases (for example, hydrogen).

Taking into account the expected adoption of the draft law, it is necessary to approve the by-laws necessary for its implementation during 2024.

PM_IMG_WAM_03 Systematic involvement of the Ukrainian side in EU processes related to the future of energy infrastructure

Purpose : to ensure that Ukraine's energy infrastructure is taken into account in the development of energy markets in the EU

Legal basis : Article 274 of the Association Agreement, Memorandum of Understanding on the Strategic Energy Partnership between Ukraine and the European Union together with the European Atomic Energy Community

Time frame : 2024-2025

Responsible bodies/organizations: Ministry of Energy, Ministry of Foreign Affairs, MES

Description: Energy infrastructure planning in the EU is a continuous and complex process, which, in particular, includes the stages of development, discussion and approval of 10-year EU network development plans (TYNDP) and EU lists of projects of common / mutual interest (PCI/PMI list), submission of applications and receiving coordinated decisions on cross-border cost sharing, submission and review of applications for funding from the Connecting Europe Facility as well as submission of applications and participation in funding projects for prospective research in this direction, in particular through the EU Innovation Fund.

Ukraine's potential is not always taken into account at the level of EU strategic documents. Ukraine and Ukrainian companies rarely participate in large-scale research projects (with the exception of, for example, the Biomethaverse project, whose participants are non-state actors from Ukraine). The participation of Ukrainian companies in the procedures of TYNDP, PCI/PMI list and, accordingly, the Connecting Europe Facility is situational; in the context of the participation of public sector companies, it is not coordinated, despite the fact that GTSO is an observer in ENTSOG, and the electricity TSO is a full participant in ENTSO-E.

On the Ukrainian side, measures will be taken to ensure that the Ukrainian energy infrastructure is taken into account during the processes:

- formation of strategic documents and relevant internal EU research conducted with the help of third-party contractors or the Joint Research Center of the European Commission;

³⁰⁰ <https://itd.rada.gov.ua/billInfo/Bills/CardByRn?regNum=6133&conv=9>

- planning and implementation of large-scale research projects (see also PM_RIC_WAM_02 Expansion of financing of scientific research in the field of renewable energy and climate innovations);
- planning and financing of critical elements of the future energy infrastructure (in particular, through the TYNDP procedures, the list of PCI/PMI projects of the European Commission, the Connecting Europe Mechanism, the European Hydrogen Bank);
- creation and functioning of the infrastructure of decarbonization of energy markets, in particular systems of monitoring of origin (traceability) and mutual recognition of guarantees of origin in accordance with the RED III Directive.

In addition, it is advisable to obtain full membership of the Ukrainian side in the EU standardization bodies (CEN, CENELEC), as well as in ENTSOG. For this, additional agreements should be reached with the European side, as well as additional organizational measures should be carried out on the Ukrainian side.

ii. Regional cooperation in this area

Electricity infrastructure

Regional cooperation in terms of the development of the electricity transmission system of Ukraine is provided, mainly, in the framework of planning and implementation of projects that strengthen the cross-border connections of the UES of Ukraine with the energy systems of the ENTSO-E member countries in order to improve their integration (interconnectivity). Such projects are agreed upon by TSOs within the framework of the Energy Community and are implemented in the format of projects of mutual interest (PMI). At the same time, Ukraine is currently not implementing projects aimed at developing the transmission system in the format of projects of common interest of the EU (PCI) or the interest of the Energy Community (PECI).

In order to develop regional cooperation, in the future there will be cooperation between the TSO of Ukraine and the TSO of other countries of the region in the format of interaction with the regional coordination center (RCC) provided for by Regulation (EU) 2019/943 on the internal electricity market. Interaction will be carried out within the framework of the functionality defined in Annex 1 to this Regulation,³⁰¹ in particular, in terms of creating a regional network model, coordinated calculation of regimes and determination of corrective actions in the region, determination of the capacity of interconnectors for allocation, etc.

Oil and gas infrastructure

"GTS Operator of Ukraine" LLC cooperates with operators of adjacent GTSS within the framework of ENTSOG, as well as within the following initiatives:

- High Level Group for Gas Connectivity of Central and Southeast Europe (CESEC);
- South-East European Gas Initiative (SEEGAS);
- European Hydrogen Backbone and other hydrogen initiatives;
- Biomethane Industrial Partnership, in particular, thematic direction 6.

iii. Where applicable, financing measures in this area at national level

Electricity infrastructure

Several sources are used to finance the development of the transmission system, the main of which are:

- the tariff for electricity transmission services, which includes an appropriate investment component for financing projects for the modernization and development of the transmission system;

³⁰¹ <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02019R0943-20220623#M1-1>

- revenues received by TSOs at auctions for the allocation of access to interconnectors;
- fees for connecting customer facilities to the electricity transmission system;
- funds raised by TSO as part of international technical assistance programs and other raised funds from IFIs.

The electricity transmission tariff is determined in accordance with the Procedure for establishing (forming) the tariff for the transmission of electricity services and is established by the Regulator.³⁰² The transmission tariff, in particular, includes costs for the implementation of the TSO investment program, which determines the scope and sources of financing of the planned projects for the transmission system development. The investment program is formed in accordance with the Procedure for developing, submitting for approval and implementing the investment program of the transmission system operator, which is an appendix to the Transmission System Code, it is also reviewed and approved by the Regulator.

According to Article 43 of the Law of Ukraine "On the Electricity Market", any income from the allocation of interconnector capacity can be used for the following purposes: guaranteeing the actual availability of allocated capacity; maintenance and increase capacity through investments in the transmission system, in particular in the construction of new cross-border transmission lines.

Along with the need to develop and modernize the transmission system within the scope specified by the TSO, the TSO also has contractual obligations regarding the development of the transmission system for connecting customer facilities. At the same time, the financing of the construction of new transmission system elements, necessary for the connection of the customer's facilities, is carried out at the expense of the customer's connection fee.

The formation of fees for connection to TSO networks is determined in accordance with the Methodology (procedure) for formation of fees for connection to the transmission system and the distribution system.³⁰³

Ways of financing projects for the modernization and development of the transmission system at the expense of IFI funds are described in p. 3.4.1.iii. of this Plan.

Oil and gas infrastructure

Financing the expenses of operators of oil and gas infrastructure facilities is possible at the expense of revenue received from customers of their services, at the expense of other investors' funds or at the expense of additional (grant) sources. So, for example, the Central European Hydrogen Corridor project claims funding from the Connecting Europe Facility. Financing of projects in the field of hydrogen is also possible at the expense of the Connecting Europe Facility, the EU Innovation Fund, including the European Hydrogen Bank, etc. At the same time, as stated above, the financing of costs for the transportation and storage infrastructure of natural gas and oil, which will not be repurposed for hydrogen activities in the future, will no longer be covered by the financing of the main EU financing mechanisms (including the Connecting Europe Facility). Thus, the main source of financing the necessary measures can be the GTSO revenue received from service customers or funds from private investors.

The ESU foresees the need to adapt the tariff and regulatory policy to the actual volumes of gas transportation and the socio-economic environment in order to ensure the long-term financial stability of the GTSO. In 2025-2029, there will be a second regulatory period for the purposes of stimulating tariff formation by "GTS Operator of Ukraine" LLC, the necessary revenues of which should include the costs of the projects specified in the NECP. At the same time, from 2025, gas transit from Russia to the EU is expected to stop, and a reduction in oil transit from Russia and the Republic of Belarus can also be expected.

³⁰² <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02019R0943-20220623#M1-1>

³⁰³ <https://zakon.rada.gov.ua/laws/show/v0585874-19#Text>

Even if it is assumed that martial law will end by the end of 2025, during the first half of 2026, in accordance with the current law of Ukraine, there will be a moratorium on raising tariffs for the distribution of natural gas, which will limit the possibilities for financing the costs of such operators.

Thus, the main orientation in matters of financing the projects included in the NECP should be on attracting financing from investors in parallel with the possibility of attracting additional (grant) funds. For this purpose, the necessary regulatory requirements should be created to facilitate the attraction of such investments.

3.4.3. Market integration

i. Policies and measures related to the elements set out in point 2.4.3

Electricity market

In 2019, Ukraine carried out a radical reform of the wholesale and retail electricity markets, moving from the "single buyer" to the EU competitive market model by introducing the appropriate institutional environment and structural organization of the market, provided for by the provisions of the Third EU Energy Package. Further transformation of the electricity market takes place within the framework of the Fourth EU Energy Package (Clean Energy Package). In terms of reforming and developing the electricity market, Ukraine implements the following basic policies and measures:

- Deepening the integration with the markets of the EU and ENTSO-E countries by increasing the capacity of interconnectors and introducing European rules for its allocation at joint auctions using the all-European trade platform Joint Allocation Office (JAO). It is also planned to couple the spot markets of Ukraine and the EU countries as soon as possible, in particular the day-ahead market and the intraday market (market coupling).
- Ensuring the proper functioning of the competitive electricity market by deepening its liberalization in combination with temporary regulatory intervention measures aimed at stabilizing the market at the stage of insufficient maturity of the competitive environment and limited integration with the markets of the EU and ENTSO-E countries. At the same time, gradual harmonization with the EU markets of spheres, methods, scope and other parameters of regulation is envisaged, in particular in terms of the application of price caps on the spot (DAM, IDM) and balancing electricity markets.
- Development of electricity exchange trading with the introduction of standardized trading products, implementation of market-based pricing in all market segments, in particular, application of real-time prices, gradual elimination of cross-subsidization.
- Stimulating regulation (tariff setting) for electric network operators in order to ensure economic conditions for the modernization and development of network infrastructure, introduction of smart grids.
- Increasing the stability and flexibility of the energy system through the development of distributed generation, the introduction of flexible generating capacities, energy storage facilities and demand-side management. On the basis of the technological development priorities of UES of Ukraine, determined by TSO as part of the generation adequacy assessment, in particular generating capacity mix, the possibility of holding tenders for the construction of generating capacity and implementing demand-side management measures with appropriate stimulation (support) mechanisms is envisaged.
- Deepening the market integration of RES electricity producers by ensuring their active participation in organized market segments and the possibility of direct electricity trade, taking into account responsibility for imbalances.
- Ensuring the protection of vulnerable consumers through direct monetized subsidies, preferential prices provided by imposing public service obligations (PSO) on individual market participants to ensure the general public interests in the process of the electricity market functioning, which must be temporary, targeted and non-discriminatory.

Individual policies and measures are disclosed in more detail in sections 3.4.3.ii-3.4.3.v. of this Plan.

ii. Measures to increase the flexibility of the energy system with regard to renewable energy production such as smart grids, aggregation, demand response, storage, distributed generation, mechanisms for dispatching, re-dispatching and curtailment, real-time price signals, including the roll-out of intraday market coupling and cross-border balancing markets

Electricity market

PM_IME_WAM_01 Implementation of smart grids

Goal: Implementation of smart grids taking into account existing and planned national and regional programs for the development and modernization of the energy sector. The expected outcomes of the 2035 Concept of the implementation of smart grids in Ukraine are:

- improving the reliability and quality of electricity supply, operational characteristics and overall productivity of the energy sector;
- increasing operational efficiency, effective integration of distributed generation, conducting remote monitoring and diagnostics, optimizing the use of assets and resources, improving the configuration of power grids;
- improving energy efficiency, which will make it possible to reduce losses in the electrical networks of transmission and distribution system operators, improve the efficiency of load management (active and reactive), reduce carbon emissions;
- reducing the frequency and duration of consumer outages;
- enabling consumers to manage electricity consumption, reduce energy costs without harming their lifestyle and excessive restrictions on electricity consumption (expected reduction of the index of average duration of long interruptions in the electricity supply (SAIDI) and the index of Electricity Not Supplied at least three times).

Legal basis: Decree of the Cabinet of Ministers of Ukraine of October 14, 2022 No. 908 "On approval of the 2035 Concept of the implementation of smart grids in Ukraine" (Official Gazette of Ukraine 2022, No. 84, Article 5201).

Time frame: 2022 - 2035.

Responsible bodies/organizations: Ministry of Energy, NEURC

Description: The development of smart grids will be carried out within the framework of the 2035 Concept of the implementation of smart grids in Ukraine approved by the Government in 2022 and the corresponding action plan for its implementation.³⁰⁴ The implementation of pilot projects specified in the action plan for the implementation of the Concept is provided on the basis of the property of economic entities (ESS operators, TSO, DSOs, electricity producers). Implementation of projects is carried out using the procedures for forming development plans and investment programs of electricity producers, TSO, DSOs, plans for reconstruction and modernization of TPPs, CHPs, approved by the NEURC.

The concept envisages the implementation of 'smart city' pilot projects, namely the integration of information and communication technologies, with the aim of effective management of the city's infrastructure. Efforts are aimed at improving the quality of life of city residents and reducing infrastructure maintenance costs.

³⁰⁴ <https://zakon.rada.gov.ua/laws/show/908-2022-%D1%80#Text>

Implementation of the Concept does not require expenditures from state and local budgets. The main current source of funding for the development of smart grids is the electricity transmission tariff of TSO and electricity distribution tariffs of DSOs. Tariffs are regulated by the Regulator (NEURC), are subject to annual review and approval and, in particular, must take into account costs for the implementation of network development measures, which are provided for in the medium- and long-term development plans of the transmission system and distribution systems, as well as in the corresponding annual investment programs of network operators. Network development plans and investment programs are subject to approval by the Regulator. At the same time, the implementation of smart grids will require significant investments, which can be made at the expense of other sources (except tariffs for the transmission and distribution of electricity), in particular, donor funding, etc.

The Ministry of Energy ensures the coordination of actions, control and monitoring of the status of the implementation of the Concept and corresponding action plan. The tool for the implementation of the Concept is an action plan with defined performance indicators.

PM_IME_WEM_01 Stimulating regulation of distribution system operators

Goal: Stimulation of investments in the modernization and development of electrical networks, achievement of targets for the quality and reliability of electricity supply.

Legal basis: resolution of the NEURC of October 5, 2018 No. 1175 "On approval of the Procedure for establishing (forming) tariffs for electricity distribution services"³⁰⁵

Time frame: from 2018

Responsible bodies/organizations: NEURC, DSOs

Description: Tariffs for distribution services for the vast majority of DSOs are built according to the principle of stimulating regulation (tariff setting), which is aimed at stimulating investments in the modernization and development of electric networks, including smart grids, as well as the achievement of target indicators regarding the quality and reliability of electricity supply by determining the necessary income of the DSOs to ensure the implementation of electricity distribution.

PM_IME_WAM_02 Development of aggregation

Goal: Creation of an institutional environment for carrying out aggregation in the electricity market.

Legal basis: the Law of Ukraine "On the Electricity Market", Resolution of the NEURC of October 18, 2023 No. 1909 "On Approval of the Licensing Conditions for Conducting Aggregation on the Electricity Market and Amendments to Some Resolutions of the NEURC".

Time frame: from 2023

Responsible bodies/organizations: NEURC

Description: Aggregation is subject to licensing, except for cases where the market participant has a license for production and/or storage, and/or supply of electricity to consumers, and/or for performing the functions of a guaranteed buyer.³⁰⁶ In order to avoid excessive concentration, the key restrictions on the aggregator's activity include the condition that the aggregation unit does not include

³⁰⁵ <https://zakon.rada.gov.ua/laws/show/v1175874-18#Text>

³⁰⁶ <https://zakon.rada.gov.ua/rada/show/v1909874-23#Text>

an electrical installation for the production of electricity with the installed capacity exceeding 20 MW.

Regarding participation in the market, the aggregator can, on a non-discriminatory basis, buy and sell electricity on the market, taking into account responsibility for imbalances, as well as provide balancing services and auxiliary services (in accordance with the law).³⁰⁷

Market participants have the right to freely enter the aggregated group and change it. The exit from the aggregated group must be carried out in the shortest possible time in compliance with the terms of the contract, but such a time cannot exceed 21 days. Penalties (fees) for leaving the aggregated group are allowed in the agreements on participation in the aggregated group. Such fees must be proportionate and must not exceed the aggregator's direct losses and/or expenses as a result of termination of the agreement, including the cost of services already provided under the agreement. Fees cannot be applied to household and small non-household consumers.

The regulator adopted a number of resolutions with the aim of legal regulation of aggregation and active consumers participation in the electricity market.³⁰⁸ In order to increase the flexibility of the energy system, as part of the implementation of the Electricity Integration Package, it will be possible for aggregators to provide flexibility services to DSOs.

PM_IME_WAM_03 Pilot projects and demand-side management programs

Goal: Development of technical capabilities and stimulation of demand-side management for household consumers.

Legal basis: ESU

Time frames: 2023-2032

Responsible bodies/organizations: Ministry of Energy

Description: The ESU envisages the implementation of pilot projects and the creation of a demand response program by 2032. The program will provide for a complex of regulatory and technical measures, which will include centralized procurement by the state and controlled sale at discounted prices to household consumers of ESS of the standardized minimum

³⁰⁷ <https://zakon.rada.gov.ua/laws/show/2019-19#n2968>

³⁰⁸ Resolution of the NEURC of February 22, 2024, No. 370, which provides for changes to the Market Rules and settles issues related to the activity of aggregators and active consumers in the electricity market;
Resolution of the NEURC of January 10, 2024, No. 57 which provides for changes to the Code of Commercial Accounting of electricity and settles issues regarding the specifics of the organization of commercial accounting for active consumers, generating units of private households, and aggregation units;
resolution of the NEURC of December 29, 2023, No. 2649, which provides for changes to the Code of the transmission system in electricity networks;
Resolution of the NEURC of January 10, 2024, No. 2 which provides for changes to the Code of the distribution system and settlement of issues regarding the activities of active consumers and aggregators;
Resolution of the NEURC of January 10, 2024, No. 3 which provides for changes to the Rules of the retail electricity market and settles issues regarding the activities of aggregators and active consumers in the retail electricity market;
Resolution of the NEURC of December 29, 2023, No. 2651 "On approval of the Procedure for the sale and accounting of electricity produced by active consumers and its payments" regarding the regulation of relations between participants of the electricity market and active consumers.

capacity (one unit for a private house/apartment), a smart socket and a smart meter, as well as the application of differentiated (time-of-use) electricity prices for household consumers. This will shift energy consumption to off-peak hours when energy prices and/or greenhouse gas emissions from electricity production are lower.

PM_IME_WAM_04 Ensuring the development of energy storage facilities

Goal: Creation of an institutional environment for the energy storage development and the participation of energy storage facilities operators in the electricity market.

Legal basis: Law of Ukraine "On the Electricity Market", Resolution of the National Energy Regulatory Commission of Ukraine of July 22, 2022 No. 798 "On Approval of Licensing Conditions for Energy Storage", ESU

Time frame: from 2022.

Responsible bodies/organizations: NEURC.

Description: The development of ESS is at the initial stage (two utility-scale ESSs with a capacity of 1 MW are operating in the UES of Ukraine). Since the RES capacities installed in Ukraine by 2023 are based on technologies dependent on weather conditions (especially wind and solar) and which operate with a low capacity factor, the expansion of the network infrastructure and the development of ESS are planned. According to the ESU, among the strategic tasks by 2025 is the active implementation of energy storage technologies with further expansion of their use in the following time horizons. It is also envisaged to create incentives / market conditions for the construction of utility-scale ESS. In particular, the introduction of long-term contracts for ESS services may be considered.

Energy storage is provided for in the Law of Ukraine "On the Electricity Market". The regulator approved the license conditions for energy storage.³⁰⁹ In order to simplify the permitting procedures, the license conditions define cases when entities using ESS do not require licensing.

Also, to simplify the procedure for connecting ESS to the network during the period of martial law, according to the Procedure for temporary connection of electrical installations to the distribution system during the period of martial law in Ukraine, DSOs connect ESS facilities by January 1, 2025 without connection fee.³¹⁰ In part, the development of small ESS will, in particular, be stimulated within the policy of stimulating the development of distributed electricity generation from renewable energy sources for the period up to 2030 (see below).

Regarding market participation, the ESS operators (as well as the aggregator) may, on a non-discriminatory basis, buy and sell electricity on the electricity market subject to liability for imbalances, as well as provide balancing and ancillary services.³¹¹ In order to ensure proper prerequisites for the development of ESS, the problem of accumulated debt on the balancing market of electricity must be solved.

In order to increase the flexibility of the energy system, as part of the implementation of the Electricity Integration Package, the possibility of providing flexibility services by ESS operators to DSOs will be provided.

³⁰⁹ <https://zakon.rada.gov.ua/rada/show/v0798874-22#Text>

³¹⁰ <https://zakon.rada.gov.ua/rada/show/v0352874-22#Text>

³¹¹ <https://zakon.rada.gov.ua/laws/show/2019-19#n2968>

PM_IME_WEM_02 Support of active consumers by self-production mechanism (net billing)

Goal: Creation of an institutional environment for the participation of active consumers in the electricity market and stimulation of the development of distributed sources of electricity generation.

Legal basis: Law of Ukraine "On Amendments to Certain Laws of Ukraine Regarding the Restoration and Green Transformation of the Energy System of Ukraine", Law of Ukraine "On the Electricity Market", Resolution of the NEURC of December 29, 2023 No. 2651 "On Approving the Procedure for the Sale and accounting for electricity produced by active consumers and payment for it".

Time frame: from 2024.

Responsible bodies/organizations: NEURC

Description: Support of active consumers under the self-production mechanism (ACSM) is carried out by guaranteeing the purchase of electricity produced mainly from alternative sources and released by the ACSM on the basis of the concluded contract for the purchase and sale of electricity under the self-production mechanism, which is an addendum to the contract on electricity supply to the consumer.³¹² Self-production mechanism (net billing) is a support scheme for active consumers, designed to encourage the consumption of self-produced electricity, according to which the cost of electricity supplied to the grid by such consumers and the cost of electricity consumed by them from the grid is offset, taking into account the cost of transmission and distribution.

The self-production mechanism enables household and non-household consumers to install generating capacity within their contractual capacity (but no more than 30 kW for household consumers and 50 kW for small non-household consumers). The technical requirements related to the connection of ACSM generating units to the network are determined by the distribution and the transmission system codes. The electrical capacity of ACSM (except for household and small non-household consumers) permitted to be supplied to the network cannot simultaneously exceed 50% of the permitted (contractual) capacity of such consumer's electrical installations intended for the consumption of electricity. ACSM with an installed generating capacity of over 1 MW must not supply to the network more than 50% of its total volume of electricity consumption for the relevant year. Otherwise, such a consumer loses the ACSM status for a calendar year.

ACSM must conclude a contract for the purchase and sale of electricity based on the mechanism of self-production with its electricity supplier. The price of selling electricity by household and small non-household consumers is determined at the level of DAM hourly prices. The price of selling electricity under net billing mechanism by non-household consumers is determined by agreement of the parties. The universal service suppliers cannot refuse a household or small non-household consumer to enter into a contract for the purchase and sale of electricity under net billing mechanism, provided that a contract for the electricity supply has been concluded with such a consumer.

The regulator adopted a number of resolutions with the aim of legal regulation of the activities of active consumers and aggregation in the electricity market (see PM_IME_WAM_02 Development of aggregation). Sale, metering of electricity produced by active consumers, and payment for it must take place in accordance with the Procedure for the sale and metering of electricity produced by active consumers, and payment for it, approved by the Regulator.³¹³

³¹² <https://zakon.rada.gov.ua/laws/show/555-15#n505>

³¹³ <https://zakon.rada.gov.ua/rada/show/v2651874-23#Text>

In order to increase the flexibility of the energy system, as part of the implementation of the Electricity Integration Package, the possibility of active consumers to provide flexibility services to DSOs will be ensured.

PM_IME_WAM_05 Stimulation of the development of distributed electricity generation from renewables for the period up to 2030

Goal: Stimulating the development of distributed generation of electricity from renewables and energy storage facilities.

Legal basis: Law of Ukraine "On Amendments to Certain Laws of Ukraine Regarding Restoration and Green Transformation of the Energy System of Ukraine".³¹⁴

Time frame: 2025 - 2030.

Responsible bodies/organizations: Ministry of Energy.

Description: The policy supports the installation of photovoltaic modules and/or wind power installations with a hybrid inverter that can work both in autonomous mode and synchronously with the grid, including in combination with ESS (hereinafter referred to as individual power system), to cover self-consumption of electricity by critical infrastructure facilities and households in autonomous mode. If appropriate, the consumers can be equipped with heat pumps.³¹⁵

The installation of individual power system is planned by introducing support in the form of:

- reimbursement of part of the loan for the purchase and installation of a individual power system, as well as a heat pump (if appropriate);
- reimbursement of part of the interest on a loan for the purchase and installation of a individual power system, as well as a heat pump (if appropriate);
- supply of equipment within the framework of international technical assistance;
- other mechanisms not prohibited by law.

During the period of martial law in Ukraine, the implementation of the policy will be carried out mainly at the expense of international financial and donor organizations in the form of loans and grants, issuance of green bonds, at the expense of investors, as well as other sources not prohibited by law.

At the first stage (2024-2026), it is planned to provide support for:

- 1) economic entities of state and communal ownership to install photovoltaic modules and/or wind power plants up to 500 kW (per object) together with hybrid inverters and ESS, providing autonomous power supply of critical infrastructure facilities, for at least 4 hours. These critical infrastructure facilities include: centralized water supply and drainage utilities; district heating systems (boiler plants, central heating points); health care facilities;
- 2) condominiums for power supply of common-use places and equipment that ensure the vital activity of multi-apartment buildings (heating systems/individual heating points, water supply, elevators, circulation/fire pumps, lighting, alarm, smoke removal, etc.);

³¹⁴ <https://zakon.rada.gov.ua/laws/show/3220-20#Text>

³¹⁵

<https://mev.gov.ua/proyekt-normativno-pravovoho-aktu/povidomlennya-pro-oprylyudnennya-proyektu-rozporvad-zhennya-1>

- 3) households for the installation of photovoltaic modules and/or wind power plants with an installed capacity of up to 10 kW, together with hybrid inverters and ESS in the ratio of 1 kW of the installed capacity of the generating unit to at least 0.5 kWh of the ESS energy capacity.

In the second stage (2027-2030), support is expected to be extended to other facilities of state and communal ownership (public buildings, educational institutions, etc.) and the extension of state support to households for the installation of individual power systems.

The order of the Cabinet of Ministers of June 7, 2024 No. 673 was approved. The procedure for providing financial state support to individuals who install generating units in their own households that produce electricity from alternative energy sources (Government Courier, 2024 p., No. 120) using the Net Billing mechanism.

The procedure determines the conditions, criteria and mechanism for providing financial state support to individuals who install generating units that produce electricity from alternative energy sources in their own households by reducing the cost of loans. State support is provided to reduce the cost of loans for the purchase and installation of photovoltaic and/or wind modules with an installed capacity of 1 kW to 10 kW, together with hybrid inverters capable of working both autonomously and synchronously with the external network, and ESS with a capacity of 1 kWh for every 1 kW of the installed capacity of the generating unit (hereinafter referred to as a hybrid power supply system). Financing of the mentioned initiative at the first stage will be carried out at the expense of the funds provided by the Energy Community Support Fund.

The goal of the policy is to achieve 200,000 individual power systems installed by active consumers during the first phase of the program, with a further increase to 500,000 systems based on the results of the second phase by 2030. The functioning of individual power systems in the electricity market is assumed to be based on the mechanism of self-production (Net Billing).

PM_IME_WAM_06 Roadmap for Development of Distributed Generation

Goal: Ensuring stimulation and balanced development of distributed generation to improve the reliability of power supply, flexibility and stability of the UES of Ukraine.

Legal basis: ESU.

Time frame: 2024 - 2030.

Responsible bodies/organizations: Ministry of Energy, NEURC, TSO, DSO, GTSO, GDSO.

Description: Within 3 months, from the date of entry into force of the NECP, the Government will approve the Roadmap for the development of distributed electricity generation for the period up to 2030. In particular, the road map should define the following measures:

- determination of the priority directions for the development of distributed generation, based on the generating capacity adequacy assessment, the balance of the power system, and depending on the possibilities of connecting distributed generation units to electric and, if necessary, gas networks;
- establishment of quantitative indicators and parameters of the annual development of distributed generation through 2030 nationwide and by Ukrainian regions, as well as by the types of networks to which distributed generation facilities are connected;
- introduction of a system of monitoring, reporting and analysis of implementation of road map measures and achievement of defined quantitative indicators and parameters of distributed generation development;
- development of regional and, if appropriate, nodal plans for distributed generation development, taking into account the priority directions determined through 2030, the existing and prospective capacity of connections to networks;
- on the basis of the approved priority directions for distributed generation development, determining the expediency of improving the regulatory framework for regulating the operation of distributed generation facilities, in terms of connecting to networks; congestion management, in particular, the possibility of providing flexibility to service distribution system

operators; participation of distributed generation facilities in all segments of the electricity market;

- development of mechanisms for financing complex measures for distributed generation development, taking into account plans and investment programs for the development of TSO/DSOs' networks, donor aid, preferential lending projects and other sources not prohibited by law. Mechanisms for financing measures to implement the road map must comply with the rules for providing state aid, unless otherwise provided by law.

In order to urgently solve the problem of the shortage of generating capacity due to Russian attacks on the energy infrastructure, the Roadmap may also include an indicative location of distributed generation facilities based on biofuels, highly flexible gas-fired generation units, energy storage installations and other technologies that fall under the criteria of distributed generation,³¹⁶ with mandatory participation of these objects in frequency and voltage regulation in networks. Such deviations, among other things, should not prevent the implementation of the Roadmap measures as a whole.

The Roadmap may provide for the development of additional stimulating mechanisms for the development of distributed generation during the period of martial law in Ukraine, in particular in terms of war risk insurance, ensuring proper payment for services on the balancing market and the auxiliary services market, pursuant to the principles of transparency and non-discrimination, etc.

Also, among the temporary short-term measures to support the development of highly flexible gas-fired generation, for the period of martial law and within six months after its cancellation, if justified by the Ministry of Energy together with the NEURC, the Cabinet of Ministers of Ukraine may make a decision on the application of simplified procedures for connecting to networks, reducing the cost of connecting distributed generation facilities to gas and electricity networks (as well as to heat networks in the case of connecting a cogeneration facility). An important prerequisite for the economically efficient operation of distributed generation facilities is the complete liberalization of the electricity market, in particular in terms of pricing (harmonization of price caps application following EU legislation). Also, to ensure the proper integration of gas-fired distributed generation facilities into the energy system and the market, additional support mechanisms may be applied that are not prohibited by law.

PM_IME_WAM_07 Tenders for the construction of generating capacity and implementation of demand-side management

Goal: Stimulating the construction of new generation capacities and implementation of demand-side management to ensure resource adequacy and flexibility of the energy system.

Legal basis: Law of Ukraine "On the Electricity Market", Resolution of the Cabinet of Ministers of Ukraine of July 10, 2019 No. 677 "On Approval of the Procedure for Conducting a Tender for the Construction of Generating Capacity and Implementation of Demand-Side Management" (Official Gazette of Ukraine, 2019, p. No. 61, Article 2126).

³¹⁶ 'distributed generation' means distributed generation as defined in point (32) of Article 2 of Directive (EU) 2019/944, as adapted and adopted by Ministerial Council Decision 2021/13/MC-EnC

Time frame: from 2024.

Responsible bodies/organizations: Ministry of Energy, NEURC, TSO.

Description: To ensure resource adequacy and flexibility of the energy system based on the technological development priorities of the UES of Ukraine, determined by the TSO by the generation capacity adequacy assessment, in particular in terms of generating capacity mix, the government plans to hold tenders for the construction of generating capacity and the implementation of demand-side management in accordance with the approved procedure for their implementation.³¹⁷ Tenders are held on the principles of non-discrimination and fair competition among participants; openness and transparency; objective and unbiased evaluation of tender proposals of participants; prevention of corruption and abuse during the competition; the impossibility of cross-subsidization to stimulate the winners of the tenders.

On the basis of Generation capacity adequacy assessment report and the results of the monitoring of the security of electricity supply, the TSO submits conclusions and proposals to the Ministry of Energy regarding the need to hold a tender, the amount of purchasing generating capacity and/or demand-side management measures, the minimum and maximum amount of additional capacity and/or the magnitude of the impact on the electrical load schedule as a result of demand-side management, technical requirements and characteristics of generating capacities and/or equipment for the implementation of demand-side management.

The decision to hold the competition is made by the Cabinet of Ministers of Ukraine at the request of the Ministry of Energy and determines:

1. terms of the competition;
2. the amount of purchase of the necessary generating capacity and/or demand-side management measures;
3. incentives and the procedure for their application for the winners of the competition, including the maximum purchase price of the service of the development of generating capacity and the minimum deadline for payment for the provided service;
4. the maximum deadline for putting generating capacity into operation and/or starting to implement demand-side management measures;
5. the minimum and maximum amount of additional capacity and/or the value of the impact on the electrical load schedule as a result of the implementation of demand-side management measures;
6. requirements regarding the minimum period of guaranteed operation (in hours) of the equipment after commissioning of generating capacity and/or demand-side management measures;
7. basic technical requirements and characteristics to ensure the necessary modes of operation of generating capacities and/or equipment for the performance of demand-side management measures.

The following support mechanisms can be used to support the winners of the competition:

- fees for the services of development of generating capacities and/or demand-side management measures, which does not exceed the maximum purchase price of the services. Such fees are carried out through the inclusion of relevant costs in the TSO tariff for electricity transmission;
- mechanism of public-private partnership (the competition is conducted in accordance with the Law of Ukraine "On Public-Private Partnership");
- provision of state aid at the expense of state or local resources and other forms of support not prohibited by law.

³¹⁷ <https://zakon.rada.gov.ua/laws/show/677-2019-%D0%BF#Text>

Decentralization of electricity production and increase of flexible capacities will support energy security at the local level. The government plans to streamline tendering procedures for the construction of highly flexible, quick-start/stop capacity and energy storage facilities to speed up the process.

PM_IME_WEM_03 Simplification and streamlining of permitting procedures for distributed generation facilities (temporary measures)

Goal: Stimulating the development of distributed generation by reducing the regulatory burden on developers of cogeneration plants and mobile (autonomous) power plants.

Legal basis: Resolution of the NEURC of November 1, 2023 No. 2053 "On Amendments to the Licensing Conditions for the Production of Thermal Energy", Resolution of the NEURC of April 25, 2023 No. 725 "On Amendments to the Licensing Conditions for the Production of Electricity".

Time frame: during the period of martial law and six months after its termination or cancellation.

Responsible bodies/organizations: NEURC.

Description: The regulator (NEURC) amended Licensing conditions for the production of thermal energy (from November 2, 2023) with the aim of simplifying the conditions for the operation of cogeneration plants with a total capacity of up to 5 MW, which are used as backup energy sources for critical infrastructure facilities and will not require licensing.³¹⁸ This norm is temporary and applies during the period of martial law in Ukraine and for six months after its termination or cancellation. The goal is to reduce the regulatory burden on developers of cogeneration plants for powering heating, water supply and drainage facilities, social institutions (education, health care (except sanatorium-resort institutions)) during emergency power outages.

The regulator amended the Licensing Conditions for the Production of Electricity (from April 25, 2023), according to which the production of electricity by mobile (autonomous) power plants (self-propelled or non-self-propelled, which can be moved by road, rail, sea or inland water transport without their devaluation and changes of purpose) will not require obtaining an electricity production license.³¹⁹ This norm is temporary and applies during the period of martial law in Ukraine and for six months after its termination or cancellation.

PM_IME_WEM_04 Prioritization of RES facilities in dispatching

Goal: Provision of conditions for increasing the volume of electricity production from renewable sources during the dispatching of electricity facilities in the power system.

Legal basis: Law of Ukraine "On the Electricity Market", Transmission System Code.

Time frame: from 2018.

Responsible bodies/organizations: NEURC, TSO.

³¹⁸

<https://www.nerc.gov.ua/acts/pro-vnesennya-zmini-do-licenzijnih-umov-provadjhennya-gospodarskoyi-diyalnosti-z-virobnictva-teplovoyi-energiyi>

³¹⁹ <https://www.nerc.gov.ua/acts/pro-vnesennya-zmin-do-licenzijnih-umov-z-virobnictva-elektrichnoyi-energiyi>

Description: According to the Transmission System Code, the following priorities are given when dispatching RES facilities:

- inclusion in the dispatch load schedule for the next day of all declared RES generating capacities;
- priority loading of RES generating capacities in dispatching;
- postponement, under the conditions of ensuring the grid operational security, unloading or curtailment of generating capacities.

At the same time, priorities are not given to RES facilities in the event of the grid operational security violations, emergency situations, if the measures necessary to normalize the operating mode of the UES of Ukraine involve incomplete loading, unloading or curtailment of these electrical installations.

Also, when dispatching generating capacities, TSO applies non-discriminatory, competitive and transparent market mechanisms when planning and implementing load schedules of generating capacities and ESS.

PM_IME_WEM_05 Compensation for curtailment of RES producers (under the “green” tariff) in re-dispatching

Goal: Creation of favorable economic conditions for the operation of renewable energy generation facilities in the conditions of curtailment by the TSO.

Legal basis: Law of Ukraine "On the Electricity Market".

Time frames: 2018-2029.

Responsible bodies/organizations: NEURC, TSO, guaranteed buyer.

Description: In the event of curtailment of electricity production by facilities using alternative energy sources, in order to ensure the grid operational security and the security of electricity supply, the TSO must provide the Regulator with information on such curtailments, indicating the reasons and measures it plans to take to prevent curtailments.³²⁰ Also, the application of curtailments of RES electricity producers operating under the "green" tariff are compensated to these producers by the TSO in the form of the purchase of a load reduction service by the electricity producer under the "green" tariff, at the expense of the costs laid down in the tariff for electricity transmission. The cost of the load reduction service by an electricity producer under the "green" tariff, provided as a result of the execution of the TSO commands, is equal to the cost of electricity not produced by such a producer.³²¹

In compliance with the Law of Ukraine "On the Electricity Market", the NEURC adopted Resolution No. 2818 of December 30, 2020 "On Approval of Amendments to the Market Rules", which approved a standard contract for the provision of load reduction services. Producers of electricity under the "green" tariff are obliged to submit bids to the TSO for the provision of load reduction services and conclude an agreement on the provision of load reduction services. The TSO compensates the producers under the "green" tariff, which are included in the balancing group of the guaranteed buyer, for the non-produced electricity, as a result of the execution of load reduction commands (received through the dedicated load management system) under assigned "green" tariffs for such electricity producers. The compensation mechanism

³²⁰ <https://zakon.rada.gov.ua/laws/show/v0309874-18#Text>

³²¹ <https://zakon.rada.gov.ua/laws/show/2019-19#n2968>

for non-produced electricity due to execution of operational security commands of the TSO is not defined by current legislation.

At the same time, compensation to producers under the "green" tariff will be provided through 2029 (as long as the "green" tariff is in effect). Starting from 2030, the financial compensation for the reduction of electricity production to RES producers, which occurs as a result of the provision of TSO commands for unloading, will take place on a non-discriminatory basis, according to the market rules and at unloading prices set in the balancing market.

PM_IME_WAM_08 Implementation of real-time pricing

Goal: Providing proper price signals for market participants based on the interaction of electricity supply and demand.

Legal basis: Law of Ukraine "On the Electricity Market" (Article 19).

Time frame: from 2025.

Responsible bodies/organizations: NEURC.

Description: The policy provides for the creation of prerequisites for a more flexible and objective reflection through prices of the dynamics of the interaction of supply and demand in the organized segments of the electricity market, as well as with the aim of deepening its integration with the electricity markets of the EU countries (market coupling).

Reducing the duration of settlement periods. Marginal pricing is applied on a competitive basis in the organized segments of the spot electricity markets (DAM and IDM) and the balancing market of Ukraine. Prices in all three market segments are the result of the interaction of supply and demand in each specific settlement period of the day and are determined on an hourly basis. For a more detailed reflection of the dynamics of supply and demand, the possibility of using a larger number of settlement periods on the DAM, IDM and balancing market by reducing their duration to 30 minutes and 15 minutes is being considered.

Introduction of negative prices. The full implementation of real-time prices implies occurring negative prices for electricity on the DAM, IDM and the balancing market, depending on the dynamics of supply and demand in each settlement period. This will provide objective signals to market participants regarding reasonable market behavior and economic actions, in particular stimulation of electricity consumption, investment in flexible generation and storage facilities, demand-side management and improvement of forecasting.

PM_IME_WEM_06 Harmonization of price caps on wholesale market segments

Goal: Application of price caps on the wholesale segments of the electricity market of Ukraine, harmonized with European markets, allowing free market-based pricing.

Legal basis: Law of Ukraine "On the Electricity Market" (Article 6).

Time frame: 2024-2025.

Responsible bodies/organizations: NEURC.

Description: The gradual harmonization of price regulation, which is carried out in the form of setting maximum and minimum price caps on the DAM, IDM, and the balancing market of electricity of Ukraine, with European approaches to determining price caps, is envisaged. This will provide correct price signals to all market participants regarding investments and optimization of market behavior. Such harmonization is one of the key prerequisites for deepening the integration (coupling) of the relevant segments of the Ukrainian electricity market with European markets, as well as attracting investments in new flexible generating capacities and other energy technologies.

PM_IME_WAM_09 Integration of spot markets (market coupling)

Goal: Ensuring the integrated operation of the day-ahead market and the intraday market of Ukraine with the relevant segments of the electricity markets of the EU countries.

Legal basis: Ukraine Plan, approved by the Order of the Cabinet of Ministers of Ukraine of March 18, 2024, No. 244-r (Official Gazette of Ukraine, 2024, No. 32, Article 2035)³²², implementation of the Electricity Integration Package³²³

Time frame: 2024 - 2026

Responsible bodies/organizations: Ministry of Energy, NEURC, Market Operator, TSO

Description: In order to increase the transparency, competitiveness, and liquidity of the electricity market of Ukraine, to ensure a more effective allocation of the available capacity of interconnectors and better operational security, the organized segments of the electricity market of Ukraine (DAM and IDM) should be coupled with the corresponding markets of European countries.

In order to implement the policy of DAM and IDM coupling, a reform should be carried out, which includes the following steps: implementation of the Electricity Integration Package; assigning the nominated electricity market operator (NEMO); implementation of the Law of Ukraine of June 10, 2023 No. 3141-IX "On Amendments to Certain Laws of Ukraine on Prevention of Abuse in Wholesale Energy Markets" (REMIT), which will allow the Regulator to carry out full-fledged market supervision.

The transposition of the Electricity Integration Package is planned by the 4th quarter of 2025. The legislative acts harmonizing Ukrainian legislation with the Clean Energy Package will be adopted and come into force. The NEMO will be appointed by the NEURC by the 4th quarter of 2025.

In accordance with the Ukraine Plan, approved by the Order of the Cabinet of Ministers of Ukraine of March 18, 2024, No. 244-r (Official Gazette of Ukraine, 2024, No. 32, Article 2035), by Q2 2026, legislation on changing the regimes of foreign economic activity of the electricity market participants will be adopted within the implementation of the legislation of the Energy Community, introduced by the decision of the Council of Ministers of the Energy Community on December 15, 2022 No. D/2022/03/MC-EnC on the implementation of Regulation (EU) 2019/942, Regulation (EU) 2019/943, Regulation (EU) 2015/1222, Regulation (EU) 2016/1719, Regulation (EU) 2017/2195, Regulation (EU) 2017/2196, Regulation (EU) 2017/1485, as well as amendments to Decisions of the Council of Ministers No. 2021/ 13/MC-EnC and No. 2011/02/MC-EnC. The list of specific laws will be finalized after the adoption of the basic Law of Ukraine on the transposition of the Electricity Integration Package.³²⁴

Ukraine, in cooperation with ENTSO-E, TSOs of neighboring ENTSO-E member countries and in accordance with the provisions of the EU acquis, in particular Regulation (EU) 2019/943, will take measures to ensure the minimum required level of cross-zonal transmission capacity available to market participants for cross-border electricity trade (at a level of at least 70%, depending on the approach to determining the capacity of interconnectors).

³²² <http://www.ukrainefacility.me.gov.ua/wp-content/uploads/2024/03/plan-ukraine-facility.pdf>

³²³ <https://www.energy-community.org/implementation/package/EL.html>

³²⁴ <http://www.ukrainefacility.me.gov.ua/wp-content/uploads/2024/03/plan-ukraine-facility.pdf>

PM_IME_WAM_10 Integration (coupling) of the balancing market

Goal: Ensuring the integrated operation of the electricity balancing market of Ukraine with the balancing markets of the EU countries.

Legal basis: Ukraine Plan, approved by the Order of the Cabinet of Ministers of Ukraine of March 18, 2024, No. 244-r (Official Gazette of Ukraine, 2024 p., No. 32, Article 2035), implementation of the Electricity Integration Package.³²⁵

Time frame: 2024 - 2026.

Responsible bodies/organizations: NEURC, Ministry of Energy, TSO.

Description: In order to ensure regional interaction of TSOs and integration of the balancing market of Ukraine with the markets of the ENTSO-E countries for the exchange of balancing services in real time, the legislative definition of such European concepts as the system operation regions (SOR)³²⁶ and the capacity calculation region (CCR),³²⁷ contractual relations of TSOs within the SOR and CCR, the involvement of TSOs in the activities of the Regional Coordination Center (RCC), the definition of the role of the RCC in the electricity market and tasks of the RCC, defines a list of pan-European rules that are mandatory for Ukrainian electricity market participants, the list of regional rules and the procedure for their adoption, and also determines the powers of ACER in the electricity market.

For full integration, European legislation will be fully implemented as part of the Clean Energy Package. According to the Ukraine Plan, approved by the Order of the Cabinet of Ministers of Ukraine of March 18, 2024, No. 244-r (Official Gazette of Ukraine, 2024, No. 32, Article 2035), by Q4 2025 legislation will be adopted and come into force within of the Electricity Integration Package, which harmonizes the legislation of Ukraine with the Clean Energy Package, which was included in the acquis of the Energy Community in December 2022.

In accordance with the requirements of the EBGL Regulation, the TSO of Ukraine, as a Contracting Party of the Energy Community, must ensure joining European balancing platforms for cross-border exchange of balancing electrical energy:

- The Platform for the International Coordination of Automated Frequency Restoration and Stable System Operation (PICASSO);
- The platform for the exchange of manual frequency restoration reserves (mFRR) - Manually Activated Reserves Initiative (MARI);
- The platform for the exchange of replacement reserves (RR) - Trans European Replacement Reserves Exchange (TERRE);
- Platform for the imbalance netting process (IN-Platform).

Gas market

PM_IMG_WEM_01 Current measures to ensure production of sufficient volumes of natural gas

Goal: ensuring natural gas production at the level of the ESU base scenario (21.5 billion m³/year by 2030)

³²⁵ <https://www.energy-community.org/implementation/package/EL.html>

³²⁶ SOR is a geographical region within which TSOs carry out operational control of energy systems.

³²⁷ CCR means the geographic area in which the coordinated capacity calculation is applied.

Legal basis: Law of Ukraine of 18.09.2018 No. 2545-VI "On ensuring transparency in extractive industries", Law of Ukraine of 15.03.2022 No. 2139-IX "On amendments to the Tax Code of Ukraine and some other legislative acts of Ukraine on the introduction of differentiated rent payments for natural gas extraction", Law of Ukraine of September 20, 2022 No. 2606-IX "On Amendments to Subsection 10 of Chapter XX "Transitional Provisions" of the Tax Code of Ukraine regarding the peculiarities of taxation with rent for the use of subsoil for natural gas extraction", Law of Ukraine of December 1, 2022 No. 2805-IX "On Amendments to of some legislative acts of Ukraine regarding support for the development of domestic industries of subsoil use", Safety rules in the oil and gas production industry, approved by the order of the Ministry of Economy of 04/27/2023

Time frame: 2024-2030 (continuous)

Responsible bodies/organizations: Ministry of Energy, State Geodesy, Ministry of Economy

Description: In recent years, the following legislative measures have been taken to stimulate domestic natural gas production:

- differentiation of rent rates for new and old wells depending on price levels (up to USD 150/thousand m³, from USD 150 to USD 400/thousand m³ and over USD 400/thousand m³), while it is guaranteed by the state that the rent rates for "new wells" will not change until 2032;
- the legal principles of regulation and organization of the collection, disclosure and dissemination of information in order to ensure transparency in the extractive industries in Ukraine are defined, taking into account the requirements of the EITI;
- establishing at the legal level the cases of granting special permits for subsoil use without holding an auction and on the basis of an auction, grounds for making changes to them, extending their validity period, as well as grounds for refusing to grant and making changes to special permits and making changes to agreements on conditions use of subsoil, which is an integral part of special permits; on the basis of this Law of Ukraine, the Cabinet of Ministers of Ukraine adopted the Procedure for holding an auction (electronic bidding) for the sale of a special permit for the use of subsoil;
- the possibility of buying and selling subsoil use rights (special subsoil use permits);
- the possibility of carrying out an assessment of mineral reserves according to international standards (in addition to the mandatory assessment according to national standards);
- digitization of the field of subsoil use and the creation of the Unified State Information System of subsoil use;
- organizational and technical requirements for safety during the design, drilling, construction and operation, overhaul and research of oil, gas and other wells related to oil and gas extraction, industrial and inter-industrial oil and gas collection systems, preparation of oil and gas to transportation through main pipelines and to the technological equipment of objects of the oil and gas production industry, which allows the use of "Air drilling" technology.

In addition, for the period of the ban on the export of natural gas, a moratorium on the payment of rent for volumes of gas produced but not sold, as well as special rules for determining the actual sales price to which rent rates are applied, has been established.

PM_IMG_WAM_04 Additional measures to ensure production of sufficient volumes of natural gas

The goal: to ensure natural gas production above the ESU base scenario, taking into account the analysis of benefits and advantages of subsidies to fossil fuel producers.

Legal basis: ESU

Time frame: 2024-2030 (continuous)

Responsible bodies/organizations: Ministry of Energy, Ministry of Environment, Ministry of Finance, State Emergency Service.

Description: In order to ensure the volume of natural gas production above the ESU base scenario, it is necessary to take a number of additional measures:

- demining the de-occupied territory of Ukraine before carrying out mining activities;
- increasing the transparency and predictability of the procedure for concluding and implementing agreements on the distribution of products due to the adoption of the draft Law of Ukraine No. 4344 "On Amendments to Certain Legislative Acts on Stimulating the Development of the Oil and Gas Extractive Industry".

A further increase in natural gas production outside the base scenario is possible due to the development of new promising areas (Black Sea shelf, production in unoccupied territories) or the use of new production methods (unconventional deposits). For this, additional measures should be taken, as well as issues related to the requirements for working pressures in the fields and the quality of natural gas supplied to the GTS (see a separate section) and the availability of equipment and technologies for extraction (see the Dimension "Research, Innovation, Competitiveness").

At the same time, it should be noted that under the National Income Strategy until 2030, approved by the Decree of the Cabinet of Ministers of Ukraine of December 27, 2023 No. 1218-r (Official Gazette of Ukraine, 2024, No. 11, Article 722) (hereinafter - NSD), during 2024, it is planned to develop legislative changes to limit the effect of preferential taxation with rent for the use of subsoil for the extraction of natural gas by limiting the time from the date of putting the well into operation, during which the wells are considered new for the purposes of taxation with rent. In addition, in the post-war period, with the participation of specialized central executive bodies with the help of international partners, the NSD envisages to carry out an analysis and assessment of the taxation of extractive industries in accordance with the needs of the country's post-war reconstruction.

While some policies and measures may incur small marginal costs (eg, administrative measures), others will require significant investment to generate new production volumes. Taking into account the fact that the implementation of additional measures leads to obtaining new volumes of production only after a minimum of 3-5 years, new investments in gas production, in particular when it comes to funds from the state budget or the public sector of the economy, should be compared from the point of view of the possibilities of alternative use for more permanent types of activities. In addition, even measures of a non-financial nature (for example, the granting of the right to use land) may in some cases limit the opportunities for RES development. At the same time, it is not excluded that the sale of natural gas during the period of expectedly high prices (at the peak of 2035-2037) may be financially beneficial for the state, including for the purpose of further investing these funds in the direction of decarbonization.

According to the recommendations of the European Commission ³²⁸, NECP should systematically describe and count all types of explicit and implicit fossil fuel subsidies provided in the form of grants, support measures, tax measures, subsidies resulting from regulatory obligations, according to the definition of energy subsidies in the EU and in the world. Currently, there is no policy in Ukraine to monitor, reduce and/or stop subsidizing fossil fuels. All various types of such subsidies must be properly systematized, described and their application controlled taking into account the goals of the NECP.

³²⁸ COM(2019) 285 final, 18.06.2019, p.14

PM_IMG_WAM_05 Opening of natural gas export

Goal: ensuring the possibility of unimpeded gas export from Ukraine to the EU and the Energy Community

Legal basis: Article 41 of the Treaty on the Establishment of the Energy Community

Time frames: 2025-2026

Responsible bodies/organizations: Ministry of Energy, Ministry of Finance

Description: In accordance with the resolution of the Cabinet of Ministers of Ukraine of December 27, 2023 No. 1402 "On approval of the lists of goods, the export and import of which are subject to licensing, and quotas for 2024" (Official Gazette of Ukraine, 2024 p., No. 11, Article 694) (with changes) for the year 2024, a zero volume of quota was approved under UCT ZED 2711 11 00 00, 2711 21 00 00 "Natural gas of Ukrainian origin of natural gas".

In general, the unimpeded export of energy products (including natural gas) is guaranteed by Article 41(1) of the Treaty on the Establishment of the Energy Community. The second part of this article allows for exceptions to this rule, in particular, for reasons of public safety, provided that such exceptions cannot be a means of arbitrary discrimination or a hidden restriction of trade between states. In addition, the end of the ban on natural gas exports is a prerequisite for exports to the EU, which is foreseen by the ESU.

The main reason for the existing restrictions is public safety, in particular the safety of natural gas supply. Since the export of natural gas can have a positive effect on other aspects of the energy markets, during 2025-2026 it is necessary to analyze alternative ways of ensuring the security of natural gas supply, which would not harm the export of natural gas to the EU and the Energy Community. At the same time, the search for alternative ways to solve the problem should be carried out taking into account the discontinued transit of natural gas from Russia through the territory of Ukraine.

One of these methods may be to strengthen control over the fulfillment of the obligations of suppliers regarding the supply of natural gas to their consumers, even in crisis situations. The relevant duties are defined by Article 5 of the Law of Ukraine "On the Natural Gas Market" and the Rules on the Safety of Natural Gas Supply, which corresponds to Regulation (EU) 2017/1938. However, the practice of their application, in particular at the beginning of a full-scale invasion in February-April 2022, shows the insufficient effectiveness of these measures.

PM_IMG_WEM_02 Creation of a technical safety system on the gas market

Purpose : to provide state supervision over the technical aspects of the natural gas market, including in everyday life.

Legal basis : Article 8, 8-1, Part 3 of Article 18 of the Law of Ukraine "On the Natural Gas Market".

Time frames: 2024-2026

Responsible bodies/organizations: Ministry of Energy, State Energy Inspectorate

Description: The Law of Ukraine "On the Natural Gas Market" defines the competence of the Ministry of Energy in the following areas:

- approval of technical and safety standards applicable to gas transportation and gas distribution systems, gas storage facilities, LNG installation, including safety regulations, minimum technical requirements for design and operation, requirements for technical inspection, requirements for professional qualifications and experience of physical and legal persons who perform construction work, engineering and technical work and maintenance of gas transportation and gas distribution systems, gas storage facilities, LNG installations;
- establishing and approving requirements for the components of the natural gas metering unit, operating rules for metering devices, the procedure for measuring volumes and determining the quality of natural gas.

The main subordinate regulatory legal act regulating these issues is the Rules of Safety of Gas Supply Systems, approved by the Ministry of Energy before the entry into force of this Law of Ukraine. At the same time, the acts of other state authorities (including the Codes of GTS, GDS and UGS) contain separate provisions on technical issues. The technical regulations for natural gas have not yet been approved. Thus, today there is a scattering of relevant norms and there is no unified system of

requirements for technical safety (which includes requirements for the operation of networks and equipment, as well as interactions between natural gas market subjects) at the state level.

In addition, for a long time, the Law of Ukraine "On the Natural Gas Market" provided for the Ministry of Energy's authority to formulate a policy in the field of technical safety (approval of the above-mentioned rules), but not to implement (control the implementation of) this policy. However, in July 2023, this Law of Ukraine was amended to define the term "state energy supervision (control)", as well as the authority of the state authority (Derzhenergonaglyad) to implement the relevant policy³²⁹. Corresponding changes were made at the beginning of 2024 to the Regulation on Derzhenergonaglyad³³⁰. In addition, there is a draft law on the second reading of the Parliament, which should clarify the powers of the Ministry of Energy and Derzhenergonaglyad in terms of ensuring technical safety³³¹.

Taking into account the adoption of the said draft law in 2024, in 2024-2026, work should be carried out on the adoption of by-laws to implement the introduced changes, as well as the establishment of the institutional capacity of Derzhenergonaglyad, with further extension of the scope of technical supervision to the entire gas sector, which poses a threat to people, property and the natural environment. This work began in 2024 and is taking place, including with the help of a technical assistance project from the EU.

PM_IMG_WAM_06 Determination of optimal technical requirements for gas injection into networks

Goal: balancing the interests of producers and operators of gas infrastructure facilities for the sake of economically justified production / extraction of gas.

Legal basis : NES, ESU

Time frames: 2024-2026

Responsible bodies/organizations: Ministry of Energy, NEURC, GTSO, gas producers.

Description: Technical issues of domestically produced natural gas supply to the gas station relate to maintenance of gas quality parameters during its supply to the gas station and maintenance of pressures at the field level.

In general, the cooperation of GTSO with gas production companies takes place within the framework of technical agreements, which, in particular, prescribe pressure values, as well as quality standards, physical and chemical parameters and other characteristics of natural gas at the reception-transfer points. GTSO receives natural gas at the entry points from gas production companies for further transportation, and the technological process of natural gas transportation through main gas pipelines of GTSO does not include processes for complex preparation and changes in the quality indicators of the transported gas.

According to the information of "GTS Operator of Ukraine" LLC, the natural gas supplied to the GTS of Ukraine from gas production enterprises contains CO₂ in amounts that violate the requirements for the quality of gas supplied to the GTS. In addition, a significant number of entry points to the GTS receive natural gas that does not meet other requirements of the GTS Code according to the following indicators:

- humidity dew point temperature,
- dew point temperature for hydrocarbons,
- higher heat of combustion.

³²⁹ <https://zakon.rada.gov.ua/laws/show/3293-20#n67>

³³⁰ <https://zakon.rada.gov.ua/laws/show/1-2024-%D0%BF#n2>

³³¹ <https://itd.rada.gov.ua/billInfo/Bills/CardByRn?regNum=6133&conv=9>

The main violations are recorded by the temperature of the moisture dew point and by the hydrocarbons of the natural gas supplied to the GTS in the summer. The dynamics of deterioration of gas quality indicators in the period from 2020 to 2023 is as follows:

- In 2020, from 6 to 16% of gas was supplied, which does not meet the requirements of the GTS Code;
- In 2021, from 3 to 24% of gas was supplied, which does not meet the requirements of the GTS Code;
- In 2022, from 6 to 33% of gas was supplied, which does not meet the requirements of the GTS Code;
- In 2023, from 11 to 67% of gas was supplied, which does not meet the requirements of the GTS Code.

The supply of natural gas to the GTS with indicators that do not meet the requirements of the GTS Code leads to significant risks and negative factors, primarily in terms of the possibility of transporting natural gas to consumers of Ukraine, through interstate connection points and to underground gas storage facilities. Inconsistency in gas quality leads to the accumulation of liquid (condensate) in main gas pipelines, as a result of which the prerequisites for the occurrence of corrosion of pipelines arise, hydrate plugs are created, and the risks of technological equipment failure at gas distribution stations and compressor stations increase.

The issue of maintaining pressures at the level of fields is the most urgent for JSC "Ukrgezvydobuvannya" considering the significant depletion of the main part of its fields, as well as historical chains of sales of extracted gas to ensure the activity of a guaranteed supplier / performance of special duties in the natural gas market at a lower than market price .

Pressures at the level of deposits of JSC "Ukrgezvydobuvannya"

Поточні тиски родовищ набагато нижчі за початкові рівні

Родовище	Рік	Тиск			Початкові запаси, млн м³	Залишкові запаси, млн м³
		Початковий, МПа	Поточний, МПа	Зниження, %		
Шебелинське	1950	24	2	90%	757 300	76 761
Західно-Хрестищенське	1968	36	4	88%	350 151	33 679
Єфреміївське	1965	35	6	82%	100 949	16 406
Мелихівське	1967	40	9	78%	80 729	13 342
Яблунівське	1977	41	10	75%	80 075	16 532
Битків-Бабинське	1958	19	4	77%	49 566	2 453
Розпашівське	1973	46	4	92%	48 641	3 156
Медведівське	1969	21	9	56%	42 386	6 857
Машівське	1962	41	8	80%	40 960	3 889
Тимофіївське	1973	42	13	70%	33 391	11 179
Опішнянське	1969	38	6	85%	28 783	4 408
Кегинівське	1963	31	7	77%	24 628	3 291
Хідновицьке	1942	9	2	77%	23 174	2 301
Солохівське	1954	41	17	59%	13 975	2 835
Ланнівське	1979	40	15	62%	12 809	4 838

Source: JSC "Ukrgezvydobuvannya"³³²

The issue of maintaining the quality of gas when it is injected into GTS/GDS is also relevant to biomethane producers. Some operators of GTS and UGS (Germany, Denmark, France) in the EU report on problems that may arise when supplying biomethane in increased volumes to existing gas networks, as well as on additional measures that should be taken. It has already been found that as a result of a significant injection of biomethane, the content of oxygen, hydrogen, terpenes, cellophanes, ammonia, etc. increases, and operators must take additional measures to transport gas from the GDS to the GTS (reverse compressors) and deodorize the gas coming from the GDS to GTS. At the same time, the Action Plan for the implementation of Ukraine's climate policy within the framework of participation in the global initiative to reduce methane emissions the "Global Methane Pledge" includes a proposal to update the requirements with the establishment of the maximum normative value of the molar fraction of oxygen for biomethane at the level of 0.5% (from the current value of 0.2% for HTS).

³³² https://ugv.com.ua/uploads/UGV_Prez_16x9_ALL_Out3.pdf

During 2024-2026, it is necessary to determine the technical requirements for gas supply (natural gas, biomethane, in the future - synthetic methane and hydrogen) to the networks, which are optimal from the point of view of the reliability of the GTS/GDS operation and the increase in extraction/production, as well as balanced from the point of view of the financial burden on the GTS/GDS operator and manufacturers, as well as effective control over their implementation. The specified optimal technical requirements must be observed by natural gas market subjects, including producers; at the same time, there must be mechanisms for monitoring the activities of these entities.

PM_IMG_WEM_03 Transition to commercial accounting of gas in energy units

Goal: ensuring the use of energy units in calculations between subjects of the natural gas market, in particular between GTSO, GSSO and customers of their services

Legal basis: Law of Ukraine of November 2, 2021. No. 1850-IX "On amendments to some laws of Ukraine regarding the introduction of accounting and calculations for the volume of gas in energy units on the natural gas market"

Time frames: 2024-2025

Responsible bodies/organizations: Ministry of Energy, Ministry of Finance, NEURC, GTSO, GDSO, GSSO.

Description: The Law of Ukraine of November 2, 2021 No. 1850-IX "On Amendments to Certain Laws of Ukraine Regarding the Introduction of Gas Volume Accounting and Calculations in Energy Units on the Natural Gas Market" provides for the use of energy units for accounting for natural gas. In July 2022, the date of entry into force of this Law of Ukraine was postponed to May 1, which follows the date of termination or cancellation of martial law in Ukraine.

In the EU, natural gas is accounted for in energy units, both in relations between sellers and buyers of gas, and in relations with operators of gas infrastructure facilities. Accounting for gas in units of volume creates obstacles for full integration into the EU energy markets, in particular in the case of the use of gas by customers in the customs warehouse regime. In addition, this problem may be exacerbated with the need to enter information on the volumes of biomethane produced into the Union database.

During the years 2024-2025, the possibility of a full transition to accounting in energy units should be analyzed (by making appropriate changes to the law) or, alternatively, the transition to accounting in energy units will become in relations where it is primarily necessary and where such implementation will not create negative impact on the rest of the domestic market (for example, in relations regarding the transportation and storage of gas in the customs warehouse regime).

PM_IMG_WEM_04 Ensuring the attractiveness of the Ukrainian oil and gas infrastructure for use by foreign customers

Goal: increasing the use of GTS and UGS capacities by customers from the EU, the Energy Community and other countries (which can be assessed depending on the increase in the number of customers, the increase in the volume of transportation/storage or the increase in tariff revenue from such services)

Legal basis: ESU

Time frames: 2024-2030

Responsible bodies/organizations: Ministry of Energy, NEURC, Ministry of Foreign Affairs, GTSO, GSSO

Description: The ESU envisages tasks related to the use of tariff policy and the creation of new commercial products with the aim of further use of the Ukrainian gas infrastructure by customers from the EU.

In recent years, separate new commercial products aimed at attracting new customers have been developed and are already in operation, namely the service of natural gas storage in Ukrainian UGSs in customs warehouse mode, as well as short-haul transportation of natural gas from the GTS. These services are in demand by customers from the EU and the Energy Community, even in the face of a full-scale invasion. In addition, new products in underground storage facilities were introduced by the resolution of the NEURC of April 3, 2024 No. 631. The resilience of Ukrainian GTS and UGS to risks

was tested as part of stress tests conducted in 2022-2023 with the involvement of the European Commission, the Secretariat of the Energy Community, and the USAID Energy Security Project.

It is necessary to maintain prices for GTSO and GSSO services that are competitive with foreign markets, as well as to stabilize tariffs during periods of uncertainty (for example, during 2024 - early 2025 r.). Yes, tariffs for GSSO services remain unchanged until April 1, 2025.³³³ A similar decision is necessary for GTSO and is expected in the first half of 2024.

In addition, in the future, within the framework of optimizing the operation of gas infrastructure objects, as well as taking into account the termination of gas transit from Russia to the EU in 2025, GTSO and GSSO, under the supervision of the NEURC and after consultations with market subjects, should consider the possibility of developing additional commercial products. In addition, the Government will take measures to amend the EU acts in order to foresee the possibility of fulfilling the obligations of EU customers to store the mandatory volume of gas in Ukrainian gas storage facilities, which requires changes to the EU acts.

PM_IMG_WAM_07 Ensuring an effective GDS management

Goal: the intended legal regime of gas distribution activities, as well as the property of the GDSO, has been created, which will increase the investment attractiveness of the GDSO

Legal basis: NES, ESU

Time frames: 2024-2030

Responsible bodies/organizations : Ministry of Energy, NEURC, management bodies of GDSO

Description: NES envisages the introduction of incentive pricing on the gas market (a similar task is provided for in the National Energy Efficiency Action Plan). The ESU determines the need for modernization and effective GDS management. At the same time, both incentive-based tariff formation and the development or modernization of networks will not be successful if the predictability of the legal regime of the relevant activity and property is not ensured.

During 2022-2023, there were significant changes in the management and conduct of natural gas distribution activities. On the basis of a number of decisions of state authorities and courts, the shares of the operators of GDS were transferred to the management of the State Joint Stock Company Chornomornaftogaz, which is part of the Naftogaz Group. Such management has a temporary nature, as it is intended for the period of the seizure of these assets.

In parallel with this, another number of decisions authorized the conclusion of contracts for the operation of GDS and their components, the owner of which is the state, and those that are on the balance sheet of Naftogaz of Ukraine, with LLC "Gas Distribution Networks of Ukraine" and the termination of similar contracts with previous operators. This decision is also of a temporary nature, since the resolution of the Cabinet of Ministers of Ukraine of November 25, 2022 No. 1335 (Official Gazette of Ukraine, 2022 p., No. 97, Art. 6042) with regard to these networks for the period of martial law in Ukraine and for five years after its termination or cancellation, an exemption from the need to conclude lease agreements was granted in accordance with the Procedure for Leasing State and Communal Property, approved by the Resolution of the Cabinet of Ministers of Ukraine of June 3, 2020 year No. 483 (Official Gazette of Ukraine, 2020 p., No. 51, Article 1585). Court appeals are currently ongoing in both directions.

At the same time, the Law of Ukraine on the Moratorium established a ban on changing tariffs for natural gas distribution from the level of 2022. Draft Law No. 6133, which is being prepared for the second

³³³ [Tariffs for gas storage in Ukrainian gas storage facilities will remain unchanged until April 1, 2025 | Naftogaz of Ukraine \(naftogaz.com\)](https://naftogaz.com.ua/en/news/tariffs-for-gas-storage-in-ukrainian-gas-storage-facilities-will-remain-unchanged-until-april-1-2025)

reading in the Parliament and should be adopted during 2024, it is envisaged to limit this ban only to domestic consumers.

This situation does not contribute to the creation of a predictable stable environment capable of attracting new investments of transparent foreign and domestic capital. Accordingly, during 2024-2029, the Ministry of Energy, together with the NEURC, should develop a comprehensive solution to this issue, which includes the following aspects: permanent legal regime of the property of GDSO, permanent legal regime of corporate rights of GDSO, optimal business and operational model and, on its basis, optimal regulatory regime for all main types of GDSO activities, proper state control over all aspects of GDSO activities.

PM_IMG_WAM_08 Increasing the effectiveness of the balancing system

Goal : improving the functioning of the GTS balancing system, ensuring the creation of a liquid short-term wholesale gas market

Legal basis: ESU, Regulation (EU) 312/2014

Time frames: 2025-2030

Responsible bodies/organizations: NEURC, Ministry of Energy, GTSO

Description: The development of the short-term wholesale market is the main task of the balancing system established by Regulation (EU) 312/2014 (hereinafter - BAL NC), which is mandatory for Ukraine from the end of 2020. The implementation of BAL NC in Ukraine began back in 2016, and in 2017 the main changes to the by-laws were adopted for this purpose.

ACER defines the following main elements of the balancing system according to BAL NC:

1. Enabling measures are available, namely: a virtual trading point has been created and the possibility of trading imbalances with the help of trading notifications has been provided, the obligations to provide sufficient information to customers for self-balancing have been fulfilled, access to the flexibility of the system has been provided through the right to submit renominations close to real time;
2. GTSO has access to and uses a trading platform where short-term standardized products are available and used as first priority during residual balancing by the GTSO;
3. There is a daily closing of imbalances (daily cashout) at the end of each gas day, and the application of prices during the daily cashout is not prevented by tolerances or other instruments;
4. The balancing neutrality of the GTSO is ensured, which means that customers receive refunds or pay additional funds to the GTS operator depending on the balance of the neutrality account, there is transparent reporting on neutrality, and funds related to neutrality are accounted for in other accounts than those from tariffs;
5. Temporary measures such as tolerances, balancing platform, alternative prices for daily closing of imbalances, etc. are not applied.

To date, a virtual trading point has already been created in the GTS, and customers of services have the right to submit trade notifications for the purpose of settling imbalances. On the information platform GTSO provides customers of transportation services with information about the forecast of non-daily-metered offtakes. GTSO has access to and uses the trading platform as the first priority when performing balancing actions. The choice of GTSO trading platform is approved by the Regulator. Marginal prices are determined on the basis of the data of such a trading platform. In general, the balancing system is daily, that is, imbalances are closed according to the results of the day and are not subject to adjustment.

At the same time, some norms of BAL NC due to objective factors have not been applied or require full implementation.

Currently, due to military restrictions, the information provided to customers for self-balancing is not fully provided to customers of transportation services in accordance with Article 32 of the BAL NC. The application of the provisions of the GTS Code regarding the neutrality of GTSO balancing activities has been postponed, which would mean that customers would receive back funds or would pay GTSO additional funds depending on the balance of the neutrality account. In addition, temporary

measures such as tolerances are applied, which is connected with the insufficient level of liquidity of the trading platform. While daily closing of customer imbalances is generally applied, certain exceptions and instruments are used to limit its effect (for example, within the PSO regime).

Full implementation of the BAL NC is required in the norms regarding the methodology of forecasting non-daily-metered offtakes. In particular, it is about the need to develop and publicize such a methodology so that suppliers can familiarize themselves with it and, among other things, complain about its incorrect application.

To improve the balancing system, it is necessary to increase the accuracy of forecasting of non-daily-metered offtakes and develop a liquid short-term natural gas market where the GTS Operator and customers of transportation services will settle imbalances.

During 2025-2030, work should be carried out on the analysis of the accuracy of forecasting natural gas offtakes that are not daily metered, the functioning of the short-term wholesale market of natural gas, as well as the implementation of the necessary measures to cancel the application of the tolerances, the introduction of fees for balancing neutrality, etc.

iii. Where applicable, measures to ensure the non-discriminatory participation of renewable energy, demand response and storage, including via aggregation, in all energy markets

Electricity market

The legislation of Ukraine provides for the non-discriminatory integration of RES production facilities into the electricity market, and also ensures their priority participation in the market.

PM_IME_WEM_07 Possibility for RES producers to choose the form of participation in the market and to freely switch between them

Goal: Promoting the integration of RES-based generating capacities into the electricity market.

Legal basis: the Law of Ukraine "On the Electricity Market", the Law of Ukraine "On Amendments to Some Laws of Ukraine Regarding the Restoration and Green Transformation of the Energy System of Ukraine".³³⁴

Time frames: 2024 - 2029

Responsible bodies/organizations: NEURC

Description: Producers of electricity from RES, which work under the "green" tariff, have the opportunity to choose the form of their participation in the market. In particular, they can be in the balancing group of the guaranteed buyer and work under the "green" tariff or sell electricity on competitive market segments (under bilateral contracts, on DAM, IDM, and balancing markets) at free prices or by the market premium (contract-for-difference) mechanism. Renewable energy producers can sell electricity independently or within balancing groups or use other forms of market participation (e.g., energy cooperatives, active consumers under the self-production mechanism, aggregation (only renewable energy generating plants with a capacity of up to 20 MW), etc.).

³³⁴ <https://zakon.rada.gov.ua/laws/show/3220-20#Text>

PM_IME_WEM_08 Non-discriminatory integration of demand-side management, energy storage and aggregation into the energy system and market

Goal: Creation of an institutional environment for the introduction of new models of participation in the electricity market in order to improve the stability and flexibility of the power system, the reliability of electricity supply to consumers.

Legal basis: the Law of Ukraine "On the Electricity Market", the Law of Ukraine "On Amendments to Some Laws of Ukraine Regarding the Restoration and Green Transformation of the Energy System of Ukraine".

Time frame: from 2024.

Responsible bodies/organizations: NEURC.

Description: The national energy policy, among other things, is aimed at ensuring the conditions and applying measures for improving energy efficiency in the electricity sector, demand-side management; promoting the production of electricity from alternative energy sources and the development of distributed generation and energy storage facilities.

The Ukrainian legislation stipulates that preference is given to attracting investments in increasing energy efficiency and demand-side management, rather than investments in increasing generating capacity, if the former is a more efficient and economical option, taking into account the positive impact on the environment as a result of reducing energy consumption and security of supply and associated distribution costs. In particular, the government introduced the Procedure for holding a tender for the construction of generating capacity and implementing demand-side management measures.³³⁵ In terms of demand-side management, TSO submits conclusions and proposals to the Ministry of Energy on the basis of the Generation capacity adequacy assessment report and the results of monitoring the security of electricity supply: 1) the need to hold tenders; 2) volume of procurement of demand-side management measures; 3) magnitude of impact on the electricity load schedule as a result of demand-side management implementation; 4) technical requirements for the equipment for demand-side management measures implementation.

When planning the development of the distribution system, the DSOs must anticipate the need for construction and/or reconstruction of the distribution system to implement energy efficiency measures, demand-side management and/or development of distributed generation and ESS.

Gas market

PM_IMG_WEM_05 Current measures to promote biomethane production

Goal: achieving biomethane production of 100 million m³/year by 2030

Legal basis : Law of Ukraine "On the Natural Gas Market", Law of Ukraine "On Alternative Fuels", Law of Ukraine of August 9, 2023 No. 3311-IX "On Amendments to Certain Legislative Acts of Ukraine Regarding the Implementation of Investment Projects with Significant Investments" , The procedure for the operation of the biomethane register, approved by the resolution of the Cabinet of Ministers of Ukraine of July 22, 2022 No. 823, the GTS Code, the GRM Code, the DSTU standard EN 16723-1:2023

Time frames: 2024-2030

Responsible bodies/organizations: Ministry of Energy, NEURC, State Energy Efficiency

Description: In recent years, the following measures have been taken to promote biomethane production:

- Legal right to access and connect to gas networks:

According to the Law of Ukraine "On the Natural Gas Market", producers of biogas or other types of gas from alternative sources have the right to obtain access to gas transportation and gas distribution systems, gas storage facilities, LNG installations, subject to compliance with technical standards and safety requirements in accordance with the law and provided that biogas or other types of gas from alternative sources, according to their physical and chemical characteristics, correspond to the legal acts on natural gas. In addition, it is stated that the provisions of this Law of Ukraine on natural gas are applied on a non-discriminatory basis to biogas or other types of gas from alternative sources, in the

event that biogas or other gas from alternative sources meets the requirements for access to gas transportation and gas distribution systems, gas storage facilities, installations LNG. The GTS Code clearly applies this provision to biomethane producers.

- Simplification of gas quality requirements for biomethane injection:

The injection of biomethane to the GTS has been simplified by increasing the permissible oxygen content in the gas supplied to the GTS and the GDS to 0.2 mol.% for the GTS and 1% for the GDS. In general, this level is within the average value in the EU and the Energy Community³³⁶.

- Approval of the standard for biomethane:

The order of the State Enterprise "Ukrainian Research and Training Center for Standardization, Certification and Quality Problems" of April 3, 2023 No. 55 adopted the DSTU standard EN 16723-1:2023 regarding natural gas and biomethane for use in transport and biomethane for injection into the natural gas network.

- Legal prerequisites for the reverse flow of gas between GTS and GDS:

The conditions for connecting biomethane plants to the GTS and GDS have been clarified, in particular, the concepts of "biomethane" and "reverse compressor station" have been introduced, and the specifics of joining this group of customers have been established.

- Support to large biomethane production projects;³³⁷
- Provisions for creating a register of biomethane, guarantees and certificates of origin of biomethane:

Law of Ukraine of October 21, 2021 No. 1820-IX "On Amendments to Certain Laws of Ukraine Regarding the Development of Biomethane Production"³³⁸ and Law of Ukraine No. 3220-IX of June 30, 2023 "On Amendments to Certain Laws of Ukraine Regarding the Restoration and "green" transformation of the energy system of Ukraine"³³⁹:

- provides for the definition of biomethane as a gas that complies with the regulations on natural gas for supply to gas networks or for use as motor fuel;
- defines the concept of guarantee of origin of biomethane and certificate of origin of biomethane;
- provides for the existence of a register of biomethane (both supplied to gas networks and liquefied or compressed biomethane) and procedures and powers for its creation and operation.

In particular, it is provided that the creation of an account in the biomethane register is carried out after conducting an independent audit of the biomethane production facility, which confirms its ability to produce biomethane and is regulated by the Procedure for the functioning of the biomethane register. Simultaneously with the annulment of the guarantee of origin of biomethane, a certificate of origin of biomethane is formed, while these procedures should be regulated by the international agreement on the interaction of registers if it is about the export of biomethane. In order to implement this Law of Ukraine, the Regulation of the Cabinet of Ministers of Ukraine of July 22, 2022 No. 823 (Official Gazette of Ukraine, 2022 p., No. 61, Article 3652) approved the Procedure for the Operation of the Biomethane Register. However, as of April 2024, the biomethane register has not been launched, and therefore the corresponding guarantees of origin are not issued.

The State Energy Efficiency Agency has observer status in the Association of Issuing Bodies since 2022.

³³⁶ CEER-ECRB Benchmarking Report on the Quality of Electricity and Gas Supply, p. 297.

³³⁷ <https://zakon.rada.gov.ua/laws/show/3311-20#Text>

³³⁸ <https://zakon.rada.gov.ua/laws/show/1820-20#n39>

³³⁹ <https://zakon.rada.gov.ua/laws/show/3220-IX#Text>

- Opening of biomethane export to the EU:

On May 16, 2024, the Law of Ukraine of March 20, 2024 No. 3613-IX "On Amendments to the Customs Code of Ukraine and other laws of Ukraine regarding the peculiarities of customs control and customs clearance of certain categories of goods" entered into force. It should unblock the export of biomethane from Ukraine. In order to implement its provisions, it is necessary to make changes to some acts of the Ministry of Finance. These measures should be taken during 2024.

PM_IMG_WAM_09 Additional measures to promote biomethane production

Goal: achieving biomethane production in the volume of 1 bcm/year by 2030

Legal basis : ESU, Plan of measures for the implementation of the climate policy of Ukraine within the framework of participation in the global initiative to reduce methane emissions "Global Methane Pledge"

Time frames: 2024-2030

Responsible bodies/organizations: Ministry of Energy, State Energy Efficiency Agency, NEURC, Ministry of Foreign Affairs, Ministry of Economy

Description: According to information received during public consultations, existing policies and measures are capable of stimulating biomethane production at the level of 50-100 mcm/year by 2030³⁴⁰. These volumes are significantly smaller than the announced potential of biomethane production in Ukraine, as well as the declared goals for 2030 of other countries with a similar base of industry development (France – 4 bcm, the Netherlands – 2 bcm). Thus, according to the estimates of the NGO "Bioenergy Association of Ukraine", under an optimistic scenario of 2030, it is possible to reach 1 bcm/year of biomethane production, distributed in the proportion of 50/50 between domestic consumption and export. In order to increase production volumes, additional measures are necessary (taking into account sustainability criteria that are in force in the EU and must be implemented in Ukraine):

- Creation of a system for monitoring the origin (traceability) of biomethane, integrated with the EU, elimination of double accounting of volumes of biomethane exported to the EU:

From the end of 2024, the Union database (UDB) for gaseous biofuels will be operational in the EU. A condition for the competitive sale of biomethane from Ukraine to the EU is the inclusion of Ukrainian producers in the UDB, as well as the adoption of measures in Ukraine that will allow, with the application of voluntary support schemes recognized by the European Commission, to ensure monitoring of the origin of biomethane, its movement and sources, as well as eliminate the possibility of simultaneous taking into account production results for reporting purposes in Ukraine and in EU member states that will be importers of Ukrainian biomethane. During 2024-2025, the Ministry of Energy, together with other state authorities, should carry out work on determining the necessary measures from the Ukrainian side and ensuring their implementation.

- Creating a system of guarantees of origin in the domestic market and ensuring their recognition in the EU:

Export of biomethane from Ukraine to the EU without guarantees of origin issued by Ukrainian authorities is commercially possible. However, the system of guarantees of origin should create conditions for increasing the demand for biomethane in the domestic market, as well as for the possibility of further introduction of a mandatory share of biomethane in the volume of gas supply/consumption.

During 2024-2025, the Biomethane Register should be put into operation. During 2025-2029, the development and implementation of measures to launch the system of guarantees of origin within the country should be carried out.

In addition, recognition of guarantees of origin issued by Ukrainian authorities in the EU can further increase the competitiveness of Ukrainian biomethane. In order to recognize the Ukrainian guarantees of origin of biomethane in the EU, it is necessary to conclude a corresponding agreement with the EU and to have a commensurate system of guarantees of origin. A suitable agreement can be reached

³⁴⁰ Public consultations held on December 13, 2023.

within the framework of amendments to the Treaty on the Establishment of the Energy Community. In addition, the recognition of guarantees of origin requires the cooperation of relevant authorities within specialized organizations, such as Associations of Issuing Bodies (AIB) or ERGaR.

- Launch of an organized solid biofuels market:

ESU notes the need to create a legislative basis for the development of trade in solid biological fuels, which consists in the creation of a biomass market and the development of legal acts that will regulate its activity.

- Access to financing from the Decarbonization Fund;
- Financial support for small biomethane producers:

The Law of Ukraine of August 9, 2023 No. 3311-IX "On Amendments to Certain Legislative Acts of Ukraine Regarding the Implementation of Investment Projects with Significant Investments"³⁴¹ provides support for significant projects of biomethane production. At the same time, according to the results of public consultations, main producers of biomethane are small productions (up to 3 million m³/year) while significant producers are large companies, potentially able to attract capital on favorable terms. Thus, the support allocated to large biomethane producers can be revised for its distribution among small enterprises. For example, the Action Plan for the Implementation of Ukraine's Climate Policy as part of participation in the Global Methane Pledge, a global initiative to reduce methane emissions, provides for partial reimbursement of the cost of facilities (up to 50 percent of the cost, and up to 70 percent of the cost for agricultural cooperatives) for the processing of animal by-products origin belonging to II and III categories, as well as reducing the cost of construction by agricultural producers of livestock complexes with biogas plants for the purpose of producing biomethane for the diversification of energy sources, accelerating the transition to "clean" energy, increasing energy savings and replacing the import of natural gas.

- Simplification of conditions for connection to gas networks (regarding time and cost of connection):

The ESU provides for a measure to simplify the connection to gas networks of biomethane producers, but does not detail this measure in sufficient detail. During public consultations, market participants announced that a significant problem for the development of the biomethane market lies in the difficulties of interaction with GDSOs/electricity DSOs (taking into account the fact that biomethane producers are often also electricity producers). The specific problems raised relate to the time and costs of connecting to the network.

In the context of time, it is possible to consider various options for regulatory incentives to shorten the terms for issuing technical conditions for connection or to use the principle of tacit consent to connection. Another approach can be the use of existing research, in particular, the creation of "renewable go-to zones" based on zoning, which has already been carried out by the NGO "Bioenergy Association of Ukraine" (UABIO) with the support of the EBRD³⁴².

In the context of the cost of connection, it is possible to consider the option of significantly reducing or at least stabilizing the cost of connection, in particular for small producers (up to 3 mcm/year), taking into account the fact that GTSO and GDSO will benefit in the future from the transportation/distribution of gas from these producers. In general, in EU countries, the costs of joining biomethane measures can be covered by the relevant operator by 60-75% (France, Germany).

One of the options (by analogy with Germany) may be to determine the maximum amount of the connection fee that can be paid by the customer in case of connection at a certain distance from the existing networks, while the remaining costs will be covered by the relevant operator. This approach creates predictability of costs for the investor, and encourages the operator to reduce the costs of overcoming barriers to connection. To cover the rest GTSO/GDSO expenses, taking into account the potential shortage of the GTSO tariff in the second

³⁴¹ <https://zakon.rada.gov.ua/laws/show/3311-20#Text>

³⁴² <https://saf.org.ua/wp-content/uploads/2022/02/BM-Zoning-Final-Report-version-2022-02-01.pdf>

regulatory period, as well as obstacles to the introduction of RAB tariff formation at the GDSO level, a separate financing program can be developed with the participation of international partners.

In addition, it is necessary to build mutual understanding between investors and network operators: holding joint seminars to explain the existing rules and develop a proposal for improving the regulatory framework, the important role of the Ministry of Energy/NEURC as a mediator of this process, where necessary, the creation of an electronic window for submitting documentation for connection, which can both improve the process of uploading and processing a package of documents, and strengthen the control of the NEURC over the process;

- Review of the approach to legal regulation of reverse compressor stations:

The decision regarding the financing of the installation of reverse compressor stations, established by the resolution of the NEURC of June 8, 2023, No. 1021, needs further refinement in view of the goal of developing a competitive market, as well as preventing the creation of conditions for monopolistic abuse of access to important infrastructure. The current regulation creates a situation where one producer of biomethane can create an infrastructure object, access to which will be needed in the future to other producers - its competitors. According to EU practice, the owners of reverse compressors are GTSO (Denmark, Austria). At the same time, taking into account the fact that there are expectations regarding the significant export orientation of the biomethane industry, the inclusion of costs for the creation of these stations in the GTSO tariff requires additional justification.

iv. Policies and measures to protect consumers, especially vulnerable and, where applicable, energy poor consumers, and to improve the competitiveness and contestability of the retail energy market

PM_IM_WAM_03 Ensuring the independence of the NEURC

Goal: to provide an institutional environment for balancing the interests of various market participants and the state.

Legal basis: Ukraine Plan, approved by Order of the Cabinet of Ministers of Ukraine of March 18, 2024, No. 244 (Official Gazette of Ukraine, 2024, No. 32, Article 2035)³⁴³

Time frames: 2024-2025

Responsible bodies/organizations: Cabinet of Ministers of Ukraine, NEURC

Description: In 2023, the Energy Community Secretariat in a special report noted certain shortcomings and the need to strengthen the institutional independence of the NEURC³⁴⁴, and the Regulator itself developed a Plan of measures to ensure its independence in accordance with Ukraine's international obligations³⁴⁵, which was sent together with a letter of justification to the Cabinet of Ministers of Ukraine.

In order to meet the requirements of the Energy Community acquis regarding the status, independence and tasks of national energy regulators, the following measures must be taken:

- by Q4 2024 - amendments to the Law of Ukraine of August 24, 2023 No. 3354-IX "On Law-Making Activities", which will exempt NEURC decisions, which are normative legal acts, from the state registration procedure;
- by Q4 2025 – amendments to the Law of Ukraine on NEURC and other acts, which will provide for the determination of a special status to ensure

³⁴³ <http://www.ukrainefacility.me.gov.ua/wp-content/uploads/2024/03/plan-ukraine-facility.pdf>

³⁴⁴ <https://www.energy-community.org/news/Energy-Community-News/2023/10/20b.html>

³⁴⁵ [...](#)

Independence of the Regulator based on the roadmap developed by the Ministry of Energy and agreed with the Secretariat of the Energy Community;

- to appoint members of the NEURC from among the candidates selected based on the results of an open and professional competition.

PM_IM_WEM_02 Provision of targeted subsidies for partial compensation of costs of housing and utility services

Goal: to provide vulnerable categories of the population with state support to reimburse the costs of paying for housing and utility services, taking into account their financial and property status.

Legal basis: the Law of Ukraine "On Housing and Communal Services", the Law of Ukraine "On the Natural Gas Market", the Law of Ukraine "On the electricity Market", Regulations on the Procedure for Assigning Housing Subsidies, approved by the Resolution of the Cabinet of Ministers of Ukraine of October 21, 1995 No. 848 (ZP of Ukraine, 1996, No. 2, Article 76; Official Gazette of Ukraine, 2000, No. 5, Article 178), the Plan of Ukraine, approved by the order of the Cabinet of Ministers of Ukraine of March 18, 2024, No. 244 (Official Gazette of Ukraine, 2024 p., No. 32, Article 2035).

Time frames: 2025-2030.

Responsible bodies/organizations: Ministry of Social Policy, Ministry of Finance.

Description: During 2018-2021, Ukraine switched from indirect subsidies to the payment of subsidies to vulnerable categories of the population in monetary form to reimburse the cost of consumed electricity, gas, heat and other housing and communal services. Citizens who receive a housing subsidy are obliged to pay the cost of actually consumed housing and communal services every month.

During 2025-2030, monitoring of the program of housing subsidies and strengthening of their targeting will be ensured as needed.

PM_IM_WAM_04 Institutional protection of vulnerable consumers

Goal: to create a system of identification and support of certain categories of consumers.

Legal basis: Law of Ukraine "On the Natural Gas Market", Law of Ukraine "On the Electricity Market".

Time frames: 2024-2026.

Responsible bodies/organizations : Ministry of Energy, NEURC, Ministry of Social Policy.

Description: The Law of Ukraine "On the Natural Gas Market" defines that vulnerable consumers are household consumers who acquire the right to state assistance in accordance with the procedure established by the Cabinet of Ministers of Ukraine, which, in particular, establishes criteria for classifying consumers as vulnerable. Vulnerable consumers have the right to a subsidy for reimbursement of costs for consumed natural gas and other targeted assistance provided in accordance with the procedure established by the Cabinet of Ministers of Ukraine, as well as to special measures to protect vulnerable consumers in relation to disconnection in critical periods in order to meet the needs of such consumers in natural gas.

The Law of Ukraine "On the Electricity Market" provides that vulnerable consumers have the right to reimbursement of costs of consumed electricity in accordance with the procedure established by the Cabinet of Ministers of Ukraine.

As of April 2024, the procedures for the protection of vulnerable gas and electricity consumers have not been approved. Their development and approval must be coordinated and are part of the road map of gradual liberalization of the gas and electricity markets, which is provided for in the Ukraine Plan, approved by the Order of the Cabinet of Ministers of Ukraine of March 18, 2024, No. 244 (Official Gazette of Ukraine, 2024, No. 32, Art. 2035), with a deadline of Q2 2026.

PM_IM_WAM_05 Application of online services for consumers (eConsumer)

Goal: to create a convenient and useful digital solution for submitting and receiving information on gas and electricity consumption.

Legal basis: ESU

Time frames: 2024-2026

Responsible bodies/organizations: Ministry of Energy, NEURC, Ministry of Digital Transformation.

Description: ESU provides for the creation of an energy consumer digital service - eConsumer, in which information from Datahubs and other sources of information will be used so that the consumer can receive useful information, identify inconsistencies, as well as exercise other rights provided for by law (supplier switching, etc.). This digital solution is part of the road map for the gradual liberalization of the gas and electricity markets, which is provided for in the Ukraine Plan, approved by the Order of the Cabinet of Ministers of Ukraine of March 18, 2024, No. 244 (Official Gazette of Ukraine, 2024, No. 32, Article 2035), with a deadline of Q2 2026.

PM_IM_WEM_03 Regulation and liberalization of retail prices

Goal: ensuring the gradual introduction of market-based pricing for energy resources.

Legal basis: Law of Ukraine No. 2479-IX of July 27, 2023 "On the peculiarities of regulating relations in the natural gas market and in the field of heat supply during martial law and the subsequent restoration of their functioning", resolution of the Cabinet of Ministers of Ukraine of June 5, 2019. No. 483 "On the approval of the Regulation on the imposition of special duties on the participants of the electricity market to ensure the general public interests in the process of functioning of the electricity market" (Official Gazette of Ukraine, 2019, No. 49, Article 1658).

Time frames: 2024-2026

Responsible bodies/organizations: Ministry of Energy, NEURC, Ministry of Finance, Ministry of Social Policy

Description: In addition to directly supporting household consumers through subsidies, Ukraine maintains relatively low regulated prices for natural gas and electricity.

The Law of Ukraine No. 2479-IX of July 27, 2023 "On the peculiarities of regulating relations on the natural gas market and in the field of heat supply during the period of martial law and the subsequent restoration of their functioning" established that during the period of martial law in Ukraine and six months after the month in which martial law will be suspended or abolished, the price of natural gas for household consumers, as well as for some related categories of consumers, is not subject to an increase from the price that was applied in relations between suppliers and relevant consumers as of February 24, 2022.

The PSO mechanism operates on the electricity market.³⁴⁶ In the natural gas market, there are PSO mechanisms, according to which the conditions of gas supply to other categories of consumers, except for domestic ones, are determined.

These measures create significant obstacles to the development of a competitive gas market as they limit price formation through forces of supply and demand and are temporary in nature. At the same time, it is assumed that differentiated electricity prices for households (time-of-use prices) will be maintained (for details, see p. 3.4.3.v of this Plan).

³⁴⁶ <https://zakon.rada.gov.ua/laws/show/483-2019-%D0%BF#Text>

The Ukraine Plan, approved by the Order of the Cabinet of Ministers of Ukraine of March 18, 2024, No. 244 (Official Gazette of Ukraine, 2024, No. 32, Article 2035), by Q2 2026 provides for the task of the Ministry of Energy and the NEURC to prepare a road map for the gradual liberalization of gas markets and electricity and the Cabinet of Ministers of Ukraine - to approve it. The roadmap will focus on:

- the steps necessary to reform PSO with the aim of gradual liberalization of market prices after the lifting of martial law;
- steps to be taken to ensure adequate protection of vulnerable consumers after the liberalization of household prices (in particular in the context of strengthening incentives for energy efficiency and demand-side management, taking into account the decentralization of energy supply, etc.).

PM_IM_WEM_04 Universal Service Supplier and Supplier of Last Resort

Goal: to ensure the reliability and uninterrupted supply of electricity and gas to consumers..

Legal basis: Law of Ukraine "On the Natural Gas Market", Law of Ukraine "On the Electricity Market"

Time frame: 2024-2030 (permanently)

Responsible bodies/organizations: Ministry of Energy, NEURC

Description: The Law of Ukraine "On the Natural Gas Market" stipulates that in certain cases and for a limited period of time, the supply of natural gas to the consumer is carried out by the supplier of last resort under the conditions determined by the Regulator. These cases refer to situations where the consumer is left without a supplier through no fault of the consumer. The supplier of last resort is determined by the Cabinet of Ministers of Ukraine for a period of three years based on the results of the competition held in accordance with the procedure established by the Cabinet of Ministers of Ukraine. During the period of martial law and for 6 months after its termination or cancellation, the supplier of last resort is appointed without competition. By Order of the Cabinet of Ministers of Ukraine of September 12, 2023 No. 793 (Official Gazette of Ukraine, 2023 p., No. 88, Article 5149), LLC "Gas Supply Company "Naftogaz of Ukraine" is designated as the supplier of "last resort" for this period. At the same time, according to the PSO Regulation approved by the Resolution of the Cabinet of Ministers of Ukraine of March 6, 2022 No. 222 (Official Gazette of Ukraine, 2022, No. 25, Article 1297), the supplier of last resort is assigned with special obligations to supply gas to individual consumer categories.

The supplier of last resort in the electricity market provides electricity supply to consumers in cases defined by the Law of Ukraine "On the Electricity Market". The supplier of last resort is determined by the decision of the Cabinet of Ministers of Ukraine based on the results of the competition. It supplies electricity to consumers at a price formed in accordance with the methodology (procedure) approved by the Regulator.

In addition, the role of a universal service supplier is provided in the electricity market. The universal service supplier cannot refuse a household and/or small non-household consumer who is located in the territory of its activity from concluding an electricity supply contract that will guarantee household and small non-household consumers the possibility of receiving electricity supply.

During 2025-2026, discrepancies should be eliminated between the status of the supplier of last resort according to the law and its current status and tasks in the market. The supplier of last resort function shall not be used for supplies outside of the defined short period or to consumers who are left without a supplier through the fault of the consumer. Other guarantees must be used to ensure reliability and uninterrupted supply to these consumers.

PM_IM_WEM_05 Ensuring consumer access to important information

Goal: protection of consumer rights, activation of consumer participation in the market.

Legal basis: Law of Ukraine "On the Natural Gas Market", Law of Ukraine "On the Electricity Market", Rules of Natural Gas Supply, Rules of the Retail Electricity Market.

Time frame: 2024-2030 (onwards).

Responsible bodies/organizations : NEURC, suppliers, GDSO, electricity DSO.

Description: Consumers (in particular household) have the right to receive information important to them. Suppliers and GDSO/electricity DSOs are obliged to post such information on the billing documents (invoices) they issue to the consumer, in the consumer's personal accounts and on the website of the supplier/GDSO/electricity DSO. The information to be posted relates to general terms and conditions of supply and contract terms, prices, means of filing complaints and claims, supplier switching, opportunities and means of improving energy efficiency, demand-side management, etc. Information in the personal accounts of consumers must contain data on the dynamics of energy consumption by the consumer, payments, etc.

PM_IM_WEM_06 Application of tools to facilitate comparison of commercial offers and consumer choice

Goal: activation of consumer participation in the market and formation of informed economic behavior.

Legal basis: -

Time frames: 2025-2026.

Responsible bodies/organizations: NEURC.

Description: In Ukraine, there are independent tools (online services) to facilitate the comparison of price offers of electricity suppliers and the consumer's decision to choose or switch the supplier.³⁴⁷ Similar tools operate in the natural gas market: for example, the "Gazoteka" service from DiXi Group³⁴⁸ and a consultation center for the public "GazPravda" from the All-Ukrainian industry association "Federation of Oil and Gas Industry Employers".³⁴⁹

Additional measures are in place on the electricity market. In order to improve the availability of information about the available commercial offers of suppliers for consumers, the Regulator acts as an aggregator of public commercial offers and publishes relevant links on its website.³⁵⁰ To indirectly stimulate competition, the Regulator uses a rating tool and publishes a rankings of companies based on indicators of the quality of electricity supply.³⁵¹ In particular, the rankings highlight the assessment of universal service suppliers in terms of the commercial quality of services (average response time to a consumer request/complaint/claim, the level of call center service within 30 seconds and the percentage of calls lost in the call center queue).

During 2025-2026, the requirements of the EU/Energy Community acquis regarding the operation of tools for facilitating the comparison of commercial offers should be implemented.

³⁴⁷ <https://rep.oree.com.ua/index.php?route=product/category&path=115>

³⁴⁸ https://gasoteka.ua-energy.org/?_ga=2.96846620.2046844725.1696501319-501792254.1693297960

³⁴⁹ <https://gazpravda.com.ua/pro-tsentr>

³⁵⁰

<https://www.nerc.gov.ua/sferi-diyalnosti/elektroenergiya/publiczni-komercijni-propozyciyi/publiczni-komercijni-proposition>

³⁵¹ <https://www.nerc.gov.ua/news/rejting-kompanij-za-pokaznikam-yakosti-elektropostachannya>

PM_IM_WEM_07 Simplified procedure for supplier switching

Goal: to ensure that consumers receive benefits from the liberalization of energy markets.

Legal basis: Law of Ukraine "On the natural gas market"; Law of Ukraine "On the Electricity Market".

Time frames: 2025-2030.

Responsible bodies/organizations: NEURC.

Description: The procedure for switching the supplier in the natural gas and electricity markets is similar, it should guarantee the consumer's right to switch the supplier and ensure the speed and convenience of the procedure for switching the supplier. This procedure includes the following requirements:

- The terms of a supply contract cannot limit the consumer's right to switch the supplier.
- Switching the supplier is free of charge. In general, no fee or other compensation for switching suppliers is permitted.
- The supplier switching at the initiative of the consumer must be completed within a period of no more than three weeks from the date of notification by the consumer of the intention to switch the supplier.

In the electricity market, at the request of the consumer, the supplier switching must be completed within a period of no more than 3 days (provided that the actual meter readings of the consumer are read by the automated commercial metering system or the consumer agrees with the previous and new suppliers of forecast data on the meter readings on the date of the supplier switching). In the natural gas market, in practice, the procedure takes place in even shorter terms, which is due to the fact that during this procedure, the actual readings of the meter are not made.

From a technical point of view, the process of switching the supplier in the electricity market is organized through the central information and communication platform DataHub, which includes the centralized register of commercial metering points.³⁵² In the natural gas market, similar functions are performed by the GTSO information platform.

During 2025-2030, the procedure for switching the supplier in both markets should be the subject of monitoring in order to timely identify shortcomings in its functioning.

PM_IM_WEM_08 Development of organized wholesale energy markets

Goal: reducing the cost of supplying energy to consumers through functioning wholesale markets

Legal basis: Law of Ukraine "On Capital Markets and Organized Commodity Markets"; Law of Ukraine "On Commodity Exchanges"; Law of Ukraine "On Amendments to Certain Laws of Ukraine on Prevention of Abuse in Wholesale Energy Markets"; Ukraine Plan, approved by order of the Cabinet of Ministers of Ukraine of March 18, 2024, No. 244 (Official Gazette of Ukraine, 2024 p., No. 32, Article 2035).³⁵³

Time frames: 2024-2030.

Responsible bodies/organizations: NEURC, National Securities and Stock Market Commission (with consent), AMCU, Ministry of Energy.

Description: The Laws of Ukraine "On Capital Markets and Organized Commodity Markets" and "On Commodity Exchanges" in the new version of the Law of Ukraine of June 19, 2020 No. 738-IX lay the foundations for the creation of organized wholesale markets in Ukraine based on the European model, including energy markets. They provide updated powers for government bodies and requirements for operators of such markets, including the concept of clearing. Thus, the activity of commodity exchanges is subject to licensing by the National Securities and Stock Market Commission. As of April 2024, 4 commodity exchanges have relevant licenses.

³⁵² <https://ua.energy/datahub/>

³⁵³ <http://www.ukrainefacility.me.gov.ua/wp-content/uploads/2024/03/plan-ukraine-facility.pdf>

For the further development of wholesale energy markets, additional measures were taken:

- Implementation of the REMIT Regulation:

With the adoption of the Law of Ukraine "On Amendments to Certain Laws of Ukraine Regarding the Prevention of Abuse in Wholesale Energy Markets" of June 10, 2023 No. 3141-IX, Ukraine fulfilled its obligations regarding the transposition of the requirements of Regulation (EU) No. 1227/2011 of the European Parliament and of the Council of October 25, 2011 on integrity and transparency in the wholesale energy market (hereinafter REMIT), as well as some provisions of Commission Implementing Regulation (EU) No. 1348/2014 of December 17, 2014 on the implementation of Article 8(2) and Article 8(6) REMIT Regulation (hereinafter – Implementation Regulation).

The specified Law of Ukraine, in particular: introduces the registration of wholesale energy market participants (electricity market participants and natural gas market subjects), reporting on the implementation of economic and trade operations on the wholesale energy market, including offers (bids); establishes the obligation of wholesale energy market participants to publicize (disclose) insider information available to them; prohibits abuse in the wholesale energy market (manipulation and attempted manipulation, trading using insider information, non-disclosure or disclosure of insider information in violation of established requirements, conducting transactions with a wholesale energy product without appropriate registration) and establishes liability in the form of fines for abuse.

The Law of Ukraine empowers the NEURC to carry out market surveillance and investigate abuses in the wholesale energy market. In order to ensure the implementation of the requirements of the Law of Ukraine and for the implementation of the provisions of REMIT, NEURC adopted a number of normative legal acts. The mentioned normative legal acts of the NEURC were adopted within the terms established by the Law of Ukraine and which were provided for by the Plan for the Ukraine Facility 2024-2027. From November 1, 2023, the NEURC is already registering participants in the wholesale energy market. From January 2, 2024, in accordance with the requirements of the Law of Ukraine, the Register of Wholesale Energy Market Participants has been operating.³⁵⁴

Taking into account the adopted by-laws and for the full implementation of the functions of NEURC in terms of market supervision and detection of abuses, NEURC carries out the necessary organizational measures, including the preparation of the Terms of Reference for the development of the information system. Subsequently, the developed IT system will be put into operation.

At the same time, the development and commissioning of the relevant IT system and the adjustment of work with the increased volume of data, the submission of which is provided for by the REMIT Regulation, requires significant financial and organizational efforts and the development of additional competencies of the Regulator. According to the REMIT, energy market participants report information in a standardized format to ACER, and national energy regulators have the right to obtain information from ACER's database and conduct their own investigations using their own IT support. In this connection, the need to ensure the maximum integration of the IT system of Ukraine with the IT system of ACER requires special attention from the European Commission.

- Interaction between regulatory bodies:

On 04/03/2024, National Securities and Stock Market Commission and NEURC signed an Agreement on interaction and cooperation, which will allow for the coordination of regulatory supervision of the activity of wholesale energy markets in accordance with EU best practices.

- International cooperation:

As part of the SEEGAS initiative, which unites representatives of Southeastern and Eastern Europe (including Ukraine) with the support of the Secretariat of the Energy Community and the EBRD, work is underway to create an effective clearing system for transactions with gas and related derivatives.

³⁵⁴ <https://www.nerc.gov.ua/dobrochesnistta-prozorist-remit/revestr-uchasnikiv-optovogo-energetichnogo-rinku>

PM_IMG_WAM_10 Additional measures for the development of the organized wholesale gas market

Goal: reducing the cost of supplying gas to consumers at the expense of functioning wholesale markets

Legal basis : -

Time frames: 2024-2026

Responsible bodies/organizations: Ministry of Energy, NEURC, National Securities and Stock Market Commission (with consent), AMCU

Description: During 2025-2026, the Ministry of Energy, together with NEURC, National Securities and Stock Market Commission and the Antimonopoly Committee of Ukraine, should analyze the state of the wholesale gas market and consider the need to take additional measures to increase the liquidity of wholesale organized gas markets, taking into account the state of development of the infrastructure of organized wholesale markets, and as well as consultations with market subjects. Liquidity in the gas market should be created both by attracting an additional resource that should be traded on organized markets, and by sufficient demand for this additional resource from buyers who are ready and able to work on these markets. In addition, organized markets must have mechanisms that make stock trading attractive to bidders, in particular reducing the risks of non-fulfillment of obligations by customers, as well as protection against price manipulation.

It should also be taken into account that by decision of 24.12.2020 №811-p adopted as part of the request for concentration in the form of acquisition of shares in LLC “Nadra Yuzivska” by PJSC “Naftogaz of Ukraine”, the Antimonopoly Committee of Ukraine (AMCU) obliged the Naftogaz Group after the concentration to provide an offer for the sale on a competitive basis, namely on the commodity exchanges, of natural gas in the amount of at least 15 percent of the total volume of commercial gas produced during the year by the entities of the Naftogaz Group (except PJSC “Ukrnafta”), without taking into account the volumes of gas sales within the framework of PSO.

Electricity market

PM_IME_WEM_09 Service quality standards and compensation to consumers for non-compliance

Goal: Improvement of the quality of electricity supply and protection of consumer rights.

Legal basis: Resolutions of the NEURC of June 12, 2018 No. 373 "On approval of the Minimum requirements for the quality of service to consumers of electricity by call centers", No. 374 "On approval of reporting forms on power supply quality indicators and instructions for their completion", No. 375 "On the approval of the Procedure for ensuring quality standards of electricity supply and providing compensation to consumers for their non-compliance".

Time frame: from 2018.

Responsible bodies/organizations: NEURC.

Description: In order to protect consumers, the Regulator approved the Procedure for ensuring quality standards of electricity supply and providing compensation to consumers for their non-compliance (determines the quality standards of services of the TSO, DSOs and suppliers),³⁵⁵ as well as Minimum requirements for the quality of service to consumers of electricity by call centers.³⁵⁶ The Procedure defines the list of general and guaranteed quality standards of electricity supply; relations related to electricity supply are regulated in accordance with defined standards; consumer rights are protected by providing compensation for non-compliance with guaranteed power supply quality standards; the amount of compensation to consumers for non-compliance with guaranteed standards has been established. The rules of the retail electricity market determine the procedure of actions of the participants of the retail market during the consideration of appeals, complaints and claims of consumers.

³⁵⁵ <https://zakon.rada.gov.ua/laws/show/v0375874-18#Text>

³⁵⁶ <https://zakon.rada.gov.ua/laws/show/v0373874-18#Text>

Consumers receive compensation for non-compliance with standards, in particular regarding: the duration of restoration of electricity supply after the interruption in electricity supply, the frequency of interruptions in electricity supply; deadlines for issuing technical conditions for connection, checking the meter, responding to consumer appeals; quality of electricity (voltage).

The regulator monitors compliance by TSO, DSOs and electricity suppliers with general and guaranteed service quality standards and the amounts of compensation provided for non-compliance with guaranteed service quality standards by analyzing relevant reports regularly provided by licensees and during surveillance measures.

To indirectly stimulate the improvement of the quality of service provision, the Regulator uses a rating tool and publishes the rankings of companies based on indicators of the quality of electricity supply.³⁵⁷

The rankings provide an assessment of DSOs and universal service suppliers. The analysis covers indicators of the reliability of electricity supply (index of the average duration of interruptions in electricity supply - SAIDI; the target reduction of the SAIDI indicator is one of the essential conditions of the RAB-regulation of the DSOs) and the commercial quality of service provision (the average time of providing a response to a consumer's request/complaint/claim, the level of service of call center within 30 seconds and the percentage of calls lost in the call center queue).

PM_IME_WEM_10 Supply of electricity to protected consumers

Goal: Ensuring reliable supply of electricity to certain categories of consumers.

Legal basis: Law of Ukraine "On the Electricity Market".

Time frame: from 2018.

Responsible bodies/organizations: Ministry of Energy.

Description: The Law of Ukraine "On the Electricity Market" (Article 60) identifies a category of protected consumers to whom a special regime of disconnection and/or limitation of electricity supply is applied to prevent the occurrence of emergencies. Disconnection of protected consumers is carried out in compliance with the requirements of the Procedure for ensuring the supply of electricity to protected consumers, approved by the Cabinet of Ministers of Ukraine, which determines: 1) the procedure for drawing up a list of protected consumers; 2) the procedure for limiting and disconnecting the electricity supply of protected consumers; 3) mechanisms for ensuring full payment by protected consumers for electricity by ensuring advance payment of the forecast volume of consumption and/or providing a financial guarantee of payment or in another way.³⁵⁸

Gas market

PM_IMG_WEM_06 Basic annual offer of natural gas supplier

Purpose : development and proper application of commercial offers of natural gas suppliers

Legal basis : Rules of supply of natural gas, Standard contract for the supply of natural gas to households

Time frame: 2024-2030 (continuous)

Responsible bodies/organizations : NEURC

Description: The supply of natural gas to household consumers in accordance with the Law of Ukraine "On the Natural Gas Market" is based on a standard contract, the terms of which cannot be changed by the parties.

³⁵⁷ <https://www.nerc.gov.ua/news/rejting-kompanij-za-pokaznikam-yakosti-elektropostachannya>

³⁵⁸ <https://zakon.rada.gov.ua/laws/show/1209-2018-%D0%BF#Text>

In order to enable suppliers to offer new products while preserving the protection of consumer rights, amendments to some acts of the NEURC introduced the concept of "basic annual offer", which every supplier that supplies gas to household consumers must offer in terms of the mandatory elements defined by the NEURC (terms effective from May 1 to April 30 of the following year, the prohibition of price increases during this period, the term and order of settlements, etc.). At the same time, the supplier has the right to independently determine the price of the basic annual offer, as well as to offer consumers other commercial offers within the flexibility provided by the Standard Natural Gas Supply Agreement.

PM_IMG_WAM_11 Strengthening requirements for unbundling of GDSO

Purpose : to eliminate restrictions on competition in the retail market from abuses by natural monopolists

Legal basis : Law of Ukraine "On the natural gas market", Directive 2009/73/EC

Time frames : 2024-2026

Responsible bodies/organizations : NEURC, Ministry of Energy

Description : The requirements for unbundling of GDSO are determined by the Law of Ukraine "On the Natural Gas Market". At the same time, these requirements should be brought into full compliance with EU best practice and recommendations of the Energy Community ³⁵⁹. Thus, according to the acquis of the EU/Energy Community, requirements for unbundling of GDSO concern legal form (legal unbundling), performance of functions and decision-making (functional unbundling), accounting unbundling (accounting unbundling). At the same time, unbundling of functions and decision-making consists of several mandatory elements, including separation at the level of governing bodies, independence and effectiveness of decision-making, separate identity, communication and branding, and preservation of confidentiality.

At the legislative level, there are no rules that would be clearly controlled by the NEURC and apply to a large part of the requirements for the performance of functions and decision-making (in particular, regarding the use of shared services and premises, separate communication with the consumer, non-distribution of information to related parties). For example, the practice of using shared premises, advertising, shared services, and other resources by GDSOs and related suppliers is common, which, however, must be clearly controlled by the NEURC.

During 2025-2026, the Ministry of Energy, together with NEURC, should carry out work on making the necessary changes to the Law of Ukraine "On the Natural Gas Market" and other regulatory acts, if necessary.

v. Description of measures to enable and develop demand response, including those addressing tariffs to support dynamic pricing

Electricity market

PM_IME_WEM_11 Time-differentiated prices for household consumers

Goal: To create economic incentives for the demand-side management application by household consumers of electricity.

Legal basis: Resolution of the Cabinet of Ministers of Ukraine of June 5, 2019 No. 483 "On approval of the Regulation on imposing special obligations on participants of the electricity market to ensure the general public interests in the process of functioning of the electricity market" (Official Gazette of Ukraine, 2019, No. 49, No. 67, No. 5385, No. 11, No. 2604).

³⁵⁹ Energy Community, UNBUNDLING OF DISTRIBUTION SYSTEM OPERATORS GUIDE AND REQUIREMENTS FOR PRACTICAL IMPLEMENTATION.

Time frame: from 2019.

Responsible bodies/organizations: Ministry of Energy.

Description: In order to incentivize household consumers to implement smart meters and manage demand, in addition to a fixed price for electricity, the government also established differentiated prices taking into account the time zones of the day - two-zone or three-zone prices, which allow partially shifting electricity consumption from peak periods to other periods of the day. In case of households are equipped with smart meters for metering the electricity consumption by time periods, the payments of household consumers for electricity are carried out at a fixed price with the use of coefficients (at the choice of the consumer):

- *two-zone price:* in the hours of the nighttime minimum load in the power system (from 23:00 to 7:00), a coefficient of 0.5 is applied to the fixed price for electricity; at other hours of the day – full fixed price;
- *three-zone price:* in the hours of the nighttime minimum load in the power system (from 23:00 to 7:00), a coefficient of 0.4 is applied to the fixed price for electricity; in the offpeak period (from 7:00 to 8:00, from 11:00 to 20:00, from 22:00 to 23:00) the full fixed price for electricity is applied; in the hours of maximum load in the system (from 8:00 to 11:00, from 20:00 to 22:00) a coefficient of 1.5 is applied to the fixed price of electricity.³⁶⁰

PM_IME_WEM_12 Dynamic prices for non-household consumers

Goal: To create economic incentives for application of the demand-side management by electricity consumers.

Legal basis: resolution of the NEURC of March 14, 2018 No. 312 "On approval of the Rules of the retail electricity market".

Time frame: from 2018.

Responsible bodies/organizations: NEURC.

Description: Since the launch of the new electricity retail market model on January 1, 2019, dynamic pricing for non-household consumers has been subject to contractual relations between suppliers and consumers. Suppliers have the right to buy electricity in various segments of the wholesale market at prices taking into account the time of day, in particular, on DAM and IDM at hourly prices, and sell it to non-household consumers equipped with smart meters (consumers of group "A") at dynamic prices, which enables demand-side management.

According to the Rules of the retail electricity market, public commercial offers of electricity suppliers must be clearly defined according to their conditions and the method of determining the price of electricity. In particular, suppliers' commercial offers may include prices differentiated by time periods of the day or hourly prices, etc.³⁶¹

Gas market

PM_IMG_WAM_12 Ensuring 100% gas metering

Purpose : ensuring the completeness of gas accounting

Legal basis: Article 18 of the Law of Ukraine "On the Natural Gas Market", the Law of Ukraine "On Ensuring Commercial Accounting of Natural Gas"

Time frames: 2024-2028

Responsible bodies/organizations: GDSOs, NEURC

³⁶⁰ <https://zakon.rada.gov.ua/laws/show/483-2019-%D0%BF#Text>

³⁶¹ <https://zakon.rada.gov.ua/laws/show/v0312874-18#Text>

Description: In accordance with Article 2 of the Law of Ukraine "On Ensuring Commercial Accounting of Natural Gas" by January 1, 2023, all natural gas consumers must be equipped with meters. A draft law extending this term to January 1, 2028 is currently in the second reading in the Verkhovna Rada of Ukraine.³⁶² Adoption of this draft law is expected in 2024.

In addition, in accordance with Part 4 of Article 18 of the Law of Ukraine "On the Natural Gas Market", the Ministry of Energy, within its powers, coordinates the implementation of a comprehensive analysis of the long-term economic benefits and costs of implementing the latest systems, including hardware, of natural gas metering, in particular those that provide the opportunity for the consumer to actively manage their own consumption and their optimal list. Based on the results of such an analysis, the same body approves the implementation plan of the selected set of measures. As of April 2024, the relevant comprehensive analysis has not been conducted. It should be carried out during 2025-2027.

PM_IMG_WAM_13 Creation of a commercial gas accounting system

Goal: ensuring the reliability of gas accounting

Legal basis: ESU, Law of Ukraine "On ensuring commercial accounting of natural gas"

Time frames: 2024-2026

Responsible bodies/organizations: Ministry of Energy, NEURC

Description: ESU envisages the creation of a Datahub by analogy with the electricity market to solve the problems of commercial gas accounting and automate the exchange of information between subjects of the natural gas market.

The creation of an information database of natural gas consumption is already provided for by Article 2-1 of the Law of Ukraine "On Ensuring Commercial Accounting of Natural Gas". The Cabinet of Ministers of Ukraine must approve provisions on this information database, which must provide for the main tasks, functional capabilities, natural gas market entities responsible for entering information about natural gas consumers, terms and procedures for entering such information, as well as other issues of its functioning. The holder of the information database and the administrator of the information database is determined by the Cabinet of Ministers of Ukraine. Protection of the information contained in the information database, in accordance with the requirements of the legislation on the protection of information in information and communication systems and on the protection of personal data, is carried out by the holder of the information database. The draft Regulation on the Information Database was published on the website of the Ministry of Energy, but has not been adopted yet.

At the same time, an important principle of the creation and functioning of this information base should be its integration with information about other energy sectors. In fact, for the electricity and gas sectors, Datahub can contain uniform data packages: for example, EIC codes of the consumer, his identity and address, current operators and suppliers, meter readings, data on metering units, their temporary absence or replacement, etc. In addition, such a solution will significantly save money on the creation of a new digital solution for the gas market. In order to fill the Datahub with heating-related information, additional legislative actions will be necessary (for example, assigning individual codes to heat consumers, which are allocated to each object of heat consumption), as well as defining a separate list of information that can be included in a single Datahub.

To create a functioning commercial accounting system, it is not enough to create a Datahub. It is necessary to integrate a separate function of the commercial accounting administrator into the work of the gas market so that he is responsible for monitoring the application of current commercial accounting rules and developing the necessary changes to them, coordinating the development of

³⁶² <https://itd.rada.gov.ua/billInfo/Bills/CardByRn?regNum=6133&conv=9>

methodological approaches to forecasting in the natural gas market, empowered with the authority to decide or give expert assessments to solve technical problems between gas market entities, and also a legitimate source of data for suppliers, consumers and other players. During 2025-2026, the Ministry of Energy, together with the NEURC, should work on adopting the necessary legislative changes for this purpose.

PM_IMG_WAM_14 Creation of conditions for the use of contractual gas demand management practices

Goal : creation of a gas demand management mechanism

Legal basis : Article 6 of the Law of Ukraine "On the Natural Gas Market"

Time frames: 2024-2027

Responsible bodies/organizations: Ministry of Energy, NEURC

Description: The Law of Ukraine "On the Natural Gas Market" provides that the market measures applied to overcome the crisis situation at all levels include, in particular, the use of contracts the terms of which provide for the interruption (stopping) of the actual supply of natural gas in some cases. According to the acquis acts of the EU/Energy Community, priority should be given to market measures (as opposed to non-market measures) when overcoming crisis situations.

In order to increase the flexibility of the energy system, in particular to enable demand management by gas consumers, it is necessary to use the experience of such countries as, for example, France, which creates legal conditions for the contractual practice of gas demand management. France's experience is both in approving the necessary changes to the legislation governing the gas market to enable contractual demand reduction contracts and their implementation, and in setting targets for the percentage of consumers to be covered by this regime. According to the specified rules, consumers have the right to conclude an agreement with GTSO/GDSO for voluntary interruption of consumption. The legislation further details which consumers can use this right, as well as the procedure for verification by the operator of the possibility of operational reduction of consumption. In this way, preparation for counteracting the negative consequences of crisis situations on the gas market takes place, among other things.

During 2024-2027, the relevant practice should be studied and, if necessary, changes to the normative legal acts should be adopted to provide an opportunity to conclude agreements on the interruption (stopping) of the actual supply of natural gas in some cases.

3.4.4. Energy poverty

Where applicable, policies and measures to achieve the objectives set out in point 2.4.4

PM_IM_WAM_06 Measures to monitor and overcome energy poverty

The goal: reducing the financial burden from market prices for energy resources for those households that need it the most.

Legal basis: ESU.

Time frames: 2024-2026.

Responsible bodies/organizations: Ministry of Energy, NEURC, Ministry of Social Policy, Ministry of Digital Transformation.

Description: ESU defines energy poverty as a situation when the cost of energy consumed by a household consumer makes up a large part of his income, which leads to the impossibility of paying for the cost of consumed energy and/or reducing its consumption and, in turn, negatively affects the quality of life. At the same time, at the legislative level, there is currently no such definition, as well as quantitative and qualitative indicators, which give reasons to be classified as energy poor.

The operational plan of measures for the implementation in 2024-2026 of the Long-term strategy for thermal modernization of buildings for the period until 2050 defines the following measures in terms of overcoming energy poverty, which must be implemented during 2024-2026:

- development of conceptual foundations of state policy to overcome energy poverty, definition of the term "energy poverty";

- definition of energy poverty criteria, vulnerable categories of citizens, persons who are below the energy poverty line;
- determining the number of people who are below the energy poverty line, according to the established categories;
- setting medium- and long-term goals for reducing the number of people living below the energy poverty line, in particular, reducing the need for benefits and subsidies for housing and communal services;
- approval of a comprehensive plan of measures to overcome energy poverty, in particular by increasing the energy efficiency of buildings, taking into account the housing subsidy system.

The ESU additionally defines the following possible measures:

- raising awareness of households about their energy consumption and providing financial support, namely establishing energy consumption control and providing a detailed report with individual advice;
- study of the feasibility of introducing subsidies for the implementation of small energy renovations for vulnerable households on the principle of "first in line for repairs" with priority given to vulnerable consumers. In addition to financial support, personalized consultations can be provided;
- studying the feasibility of providing financial support for the installation of photovoltaic systems to provide households with electricity.

3.5. Dimension research, innovation and competitiveness

i. Policies and measures related to the elements set out in point 2.5

Implementation of programs in the field of energy decarbonization, green energy transition, hydrogen exports, implementation of energy storage facilities, microgrids and smart grids, projects in the field of green metallurgy require both large-scale retraining of existing workers in the energy sector and other related sectors, as well as training of a new generation of specialists for design, implementation and operational activities of new projects in energy and related sectors.

PM_RIC_WEM_01 Modernization of educational programs in order to cover the skills gap in the field of green transition and renewable energy

Goal: training specialists for new projects in energy and related sectors

Legal basis: Strategy for the Development of the Sphere of Innovative Activity for the Period until 2030³⁶³, the draft Strategy for the Development of Innovative Activity of Ukraine until 2030

Time frames: 2024-2030

Responsible bodies/organizations: Ministry of Energy, Ministry of Education and Science

Description: The post-war reconstruction of the energy sector according to the advanced technologies specified in the government's strategic documents will require the cooperation of the Ministry of Energy, the Ministry of Education and Science, and other stakeholders to create and modernize relevant educational programs in the higher and professional education sector. Modernizing the material and technical support of scientific institutions and educational institutions, which is used to train specialists in the field of energy, and the creation of international partnerships in this direction are also an urgent task.

³⁶³ <https://zakon.rada.gov.ua/laws/show/526-2019-%D1%80#Text>

Among the national strategic documents that prioritize the modernization of educational programs for the transition of the Ukrainian economy to a new level of development, the current Strategy for the Development of the Sphere of Innovative Activity for the Period until 2030 includes the need to:

- creation with the involvement of world experts, trainers, mentors, the European Entrepreneurship Network (EEN) of schools for the exchange of experience and national resources for teaching entrepreneurship and innovation, in particular, a professional development network for both teachers and heads of higher education institutions and scientific institutions;
- improving the quality of education by bringing it closer to the needs of the global market and the needs of specialists capable of creating, adapting and using technological innovations;
- ensuring state support for the creation and effective functioning of innovative infrastructure elements in institutions of higher education, scientific institutions and other subjects of innovative activity;
- ensuring state support for the creation and effective functioning of the continuous chain 'startup-school-accelerator-business-incubator' based on institutions of higher education and scientific institutions;
- promoting the creation of clusters that will unite industrial enterprises with institutions of professional (vocational and technical) education and with scientific institutions and institutions of higher education.

One of the key program documents of public policy can be the Innovation Development Strategy, the development process of which was launched by the Ministry of Digital Transformation together with the Ministry of Education and Science³⁶⁴. The document is at the approval stage, but preliminary versions of the strategy, which have been posted for public discussion, focus on the needs of staffing and educational modernization for the green transition:

"...implementation of programs in the field of energy decarbonization, green energy transition, hydrogen export, implementation of energy storage facilities, microgrids and smart networks, projects in the field of green metallurgy require both large-scale retraining of existing workers in the energy sector and other related sectors, as well as training of a new generation specialists for the design, implementation and operational activities of new projects in energy and related sectors. The modernization of the material and technical support of scientific and educational institutions, which is used for the training of specialists in the field of energy and other branches of green transformation, and the creation of international partnerships in this direction is also an urgent task³⁶⁵.

According to experts of the Resource and Analysis Center "Society and Environment", the green vector of post-war reconstruction creates significantly more jobs than the "business as usual" approach. In the case of the green reconstruction scenario, these are also green jobs with a focus on climate and energy innovations.

³⁶⁴ "The presentation of the global innovative vision of WinWin took place", Pub. December 15, 2023

<https://mon.gov.ua/ua/news/vidbulasya-prezentaciya-globalnoyi-innovacijnoyi-viziyi-winwin>

³⁶⁵ <https://winwin.gov.ua/>

Calculation of the need for jobs for the reconstruction of Ukraine under the base and green scenarios



Source: "Green jobs and post-war reconstruction of Ukraine" ³⁶⁶

One of the biggest barriers in the direction of green recovery, after a lack of capital, is the shortage of qualified personnel, which can only be partially covered by the involvement of external personnel resources. Therefore, the development of human resources is one of the priorities in the sector of research, innovation and competitiveness.

PM_RIC_WAM_01 Development of corporate and international partnerships in the energy and climate sector

Goal: professional development to ensure the use of new technologies

Legal basis: ESU, Law "On Scientific and Scientific-Technical activity" ³⁶⁷

Time frames: 2025-2030

Responsible bodies/organizations: Ministry of Energy, Ministry of Education and Science, business entities

Description: Considering the long duration of the cycle of training specialists for the energy industry through the system of higher and professional education, it is extremely important to plan (together with Ukrenergo, DSOs, JSC Naftogaz of Ukraine, and other players of the energy market of state and private ownership) and implement training programs for specialists working in the energy sector to ensure their ability to implement and operate projects in such areas as:

- Decentralized generation and micro-grids
- Smart grids
- Energy storage installations
- Electrolyzers, hydrogen synthesis, safe storage and transportation of hydrogen,
- Green ammonia, its production, storage and transportation
- Energy efficiency and energy efficient construction.
- Cyber security in energy systems, and others.

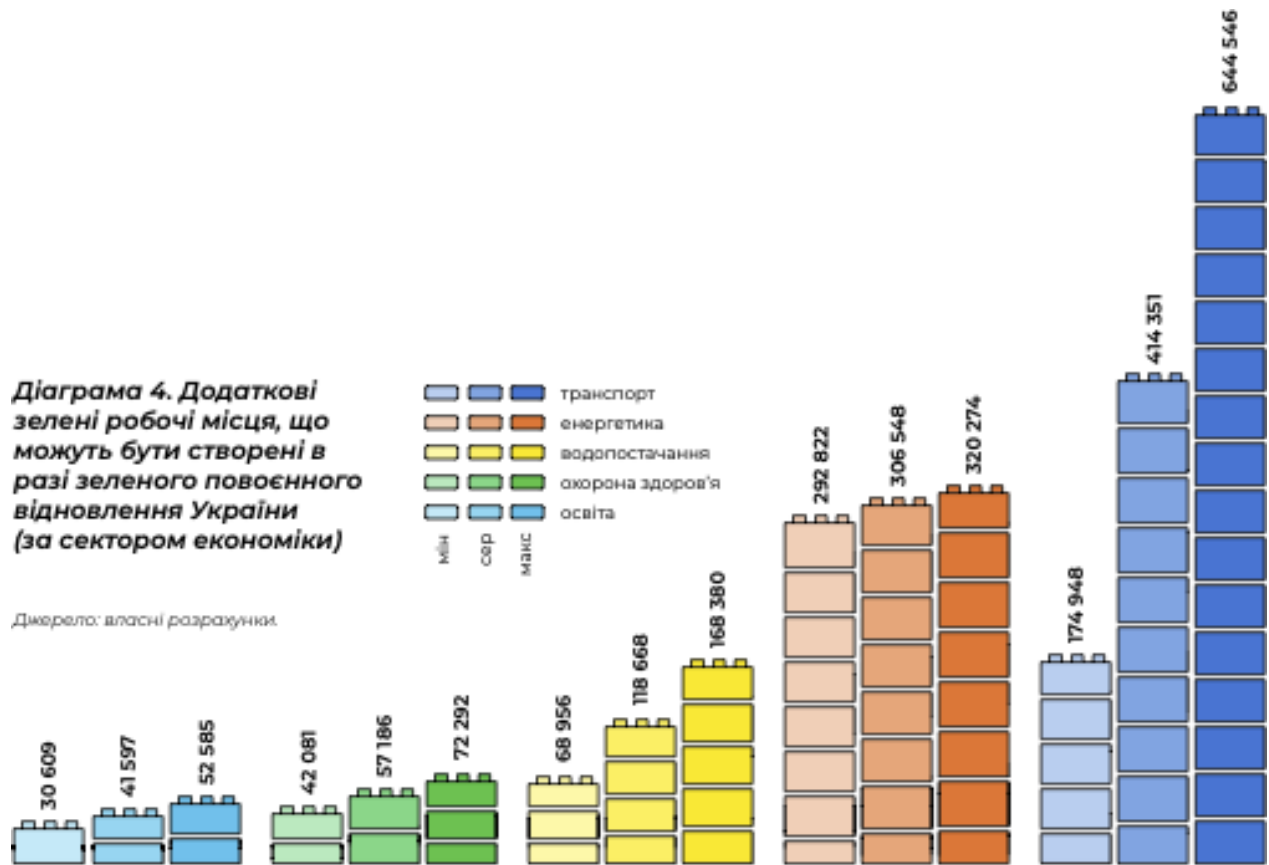
³⁶⁶ Green jobs and post-war reconstruction of Ukraine. Auth. Col.: Andrusevich A., Andrusevich N., Kozak Z. Ptashnyk I., Romanko S. - Analytical document. - October 2023

³⁶⁷ <https://zakon.rada.gov.ua/laws/show/848-19>

The implementation of such training programs will require the involvement of state funds, as well as funds from international donors, international financial organizations, and energy sector companies.

In order to accelerate the launch of specialized educational programs, it is important to involve leading international educational institutions that have successful programs in the fields of distributed generation, decarbonization of energy, artificial intelligence for energy, hydrogen energy, and other areas defined by the strategic documents of the government, to the creation of joint educational courses and accredited educational programs. Exchange and academic mobility programs are also an effective tool for access to advanced knowledge in the field of energy modernization.

The dynamics of the creation of innovative jobs possible under different reconstruction scenarios (under the basic and green scenarios)



Source: "Green jobs and post-war reconstruction of Ukraine"

Special attention will be needed to modernize the training of specialists in the field of nuclear energy, because the introduction of technologies of small modular reactors and reactors with the possibility of power maneuvering will rely on a different culture of operation and management, a different technological base than the Soviet-style reactors built in Ukraine.

PM_RIC_WEM_02 Availability of grant funding for scientific research in the field of renewable energy and climate innovation

Goal: development of scientific and research cooperation

Legal basis: Law of Ukraine "On Priority Areas of Innovative Activity in Ukraine"³⁶⁸, Law of Ukraine "On Scientific and Scientific-Technical Activity"³⁶⁹, Resolution of the Cabinet of Ministers of Ukraine of July 4, 2018, No. 528 "On the National Research Fund of Ukraine" (Official Gazette of Ukraine, 2018, No. 55, Article 1915)³⁷⁰, Law of Ukraine "On priority areas of development of science and technology"³⁷¹, Procedure for formation of topics of scientific research and scientific and technical (experimental) developments financed from the state budget³⁷², approved by the Resolution of the Cabinet of Ministers of Ukraine of January 11, 2018, No. 13 (Official Gazette of Ukraine, 2018, No. 3558, Article 313).

Time frames: 2021-2030

Responsible bodies/organizations: National Research Fund of Ukraine, Ministry of Education and Science, Ministry of Energy, Ministry of Environment

Description: In accordance with Article 5 of the Law of Ukraine "On priority areas of development of science and technology", the list of priority thematic areas of scientific research and scientific and technical development for the period until December 31 of the year following the termination or cancellation of martial law in Ukraine was approved by the Resolution of the Cabinet of Ministers of Ukraine of April 30, 2024, No. 476 (Official Gazette of Ukraine, 2024, No. 43, Article 2613)³⁷³. Among them is the direction "Energy and energy efficiency" with the following topics:

- Systems of generation and transportation of electric and thermal energy;
- Fuel bases, transportation and use systems;
- Technologies for the development and use of new types of fuel, renewable and alternative sources of energy and types of fuel;
- Energy efficiency and energy saving, energy markets;
- Energy management, information-analytical and normative-methodological support of the energy industry.

At the same time, the thematic direction "Environmentally balanced energy security" is included in the direction "National security and defense", and related topics are recorded in the directions "Information and communication technologies" and "Rational nature management".

In accordance with the fifth part of Article 5 of the Law of Ukraine "On Priority Areas of Innovative Activity in Ukraine", the Cabinet of Ministers of Ukraine by Resolution No. 1056 of December 28, 2016, approved medium-term priority areas of innovative activity at the national level for the period until December 31 of the year following the termination or cancellation of martial law in Ukraine (Official Gazette of Ukraine, 2017, No. 8, Article 237)³⁷⁴. Among them is the direction "Development of new energy transportation technologies, implementation of energy-efficient, resource-saving technologies, development of alternative energy sources" with the following topics:

- Systems of generation and transportation of electric and thermal energy;
- Fuel bases, transportation and use systems;
- Technologies for the development and use of new types of fuel, renewable and alternative sources of energy and types of fuel;

³⁶⁸ <https://zakon.rada.gov.ua/laws/show/3715-17#Text>

³⁶⁹ <https://zakon.rada.gov.ua/laws/show/848-19>

³⁷⁰ <https://zakon.rada.gov.ua/laws/show/528-2018-%D0%BF#Text>

³⁷¹ <https://zakon.rada.gov.ua/laws/show/2623-14#n32>

³⁷² <https://zakon.rada.gov.ua/laws/show/13-2018-%D0%BF#n12>

³⁷³ <https://zakon.rada.gov.ua/laws/show/476-2024-%D0%BF#Text>

³⁷⁴ <https://zakon.rada.gov.ua/laws/show/1056-2016-%D0%BF#Text>

- Energy efficiency and energy saving, energy markets;
- Environmentally balanced energy security.

Relevant topics were recorded in the areas of "Wide application of technologies for cleaner production and environmental protection", "Development of modern information, communication technologies, robotics".

A significant part of the technologies, the implementation of which is planned in the relevant program documents of the government, are still in the phases of scientific research or experimental operation. The development of international cooperation in energy science, innovative metallurgy, and other sectors is an important direction for overcoming the technological gap that has characterized the sector for the past decades.

The status of a candidate country for joining the European Union provides additional opportunities for access to the European innovation and scientific ecosystem, which in particular provides for significant funding mechanisms for energy and climate science, in particular in the field of decarbonization, green hydrogen, distributed generation, cyber security and other relevant areas.

Creation of the Horizon Europe office in Ukraine³⁷⁵ on the basis of the National Research Fund of Ukraine opens up new opportunities for cooperation between Ukrainian researchers, scientists, innovative enterprises and ecosystem organizations with European research, scientific and innovation centers and institutions such as the European Innovation Council, European Institute of Technology and Innovation, Euratom. With a budget of 95.5 billion EUR for 2021-2027, the EU framework program for research and innovation Horizon Europe is a powerful source of funding for research cooperation of European innovators, and has among its key priorities (as part of Pillar II) the direction "Climate, energy, mobility". It is expected that the direction of green transformation will be among the priority areas of grant programs that will be implemented by the National Research Fund in cooperation with Horizon Europe.

The existing grant programs of the National Research Fund, which provide, in particular, grants of up to 50,000/100,000 EUR for scientific projects of Ukrainian researchers, are also a powerful mechanism for financing research and innovation projects relevant to the sphere of decarbonization and modernization of Ukrainian energy.

PM_RIC_WAM_02 Expansion of funding for scientific research in the field of renewable energy and climate innovation

The goal: involvement of knowledge and technology to overcome the technology gap

Legal basis: Law "On Scientific and Scientific-Technical activities"³⁷⁶, Resolution of the Cabinet of Ministers of Ukraine of July 4, 2018, No. 528 "On the National Research Fund of Ukraine" (Official Gazette of Ukraine, 2023, No. 72, Article 4114; 2023, No. 77, Article 4357)³⁷⁷

Time frames: 2025-2030

Responsible bodies/organizations: National Research Fund of Ukraine, Ministry of Education and Science, Ministry of Finance, Ministry of Energy, Ministry of Environment and Natural Resources

Description: National Research Fund of Ukraine promotes the development of scientific connections between Ukrainian and foreign research institutions, which is relevant for the development of modern areas of energy and climate science. However, in order to achieve a tangible effect in energy and climate research, a significant increase in funding is necessary, according to expert estimates to at least 250 million EUR per year.

³⁷⁵ <https://nrfu.org.ua/news/vidbulasya-urochysta-czeremoniya-vidkryttya-ofisu-goryzont-yevropa-v-ukrayini/>

³⁷⁶ <https://zakon.rada.gov.ua/laws/show/848-19>

³⁷⁷ <https://zakon.rada.gov.ua/laws/show/528-2018-%D0%BF#Text>

In this direction, the development of scientific and research diplomacy with key partner countries for Ukrainian energy and green reconstruction is important. In addition to the European Union, the United States of America, United Kingdom, Japan, South Korea, Scandinavian countries, Switzerland and other leading countries in the field of energy innovation and green transformation can become key partners in this direction.

Cooperation with the listed partners in the field of energy research and innovation will allow to attract critical knowledge and technologies to overcome the technology gap in the sector. Also, joint projects with them create the basis for further attracting funding for research and innovation in the field of energy and climate.

Ambitious plans declared by the government of Ukraine in the field of development of renewable energy, hydrogen energy, localization of energy equipment production, localization of production of small modular reactors and fuel assemblies for nuclear power plants, and other areas are extremely science-intensive and require the formation of a new research and innovation ecosystem. For full deployment, the need to finance research and innovation activities will amount to 750 million EUR per year.

The scale of the tasks facing Ukraine in the context of the development of research and innovation in the context of energy and climate are not unique. These challenges face all countries that are restructuring their economies to become carbon neutral. According to data provided by the IEA in the ETP Clean Energy Technology Guide database, today there are more than 550 innovative technologies and components in the world "which are thoroughly present in the entire energy system, contributing to the achievement of the net-zero goal"³⁷⁸.

PM_RIC_WEM_03 Development of corporate investments in the purchase of climate technologies and renewable energy solutions

Goal: creating favorable conditions for investment

Legal basis: -

Time frames: 2024-2030

Responsible bodies/organizations: Ministry of Economy, Ministry of Energy, Ministry of Environment and Natural Resources, other stakeholders

Description:

Increasing the energy efficiency of industry

Reducing the energy consumption of industry per unit of GDP in Ukraine is an important reserve in the matter of decarbonization, energy security and enabling the exports of energy resources as one of the growth factors of the Ukrainian economy.

The outdated production base, the lack of adequate energy management mechanisms, the high cost of capital for capital investments reduce the competitiveness of Ukrainian enterprises on international markets, especially considering the implementation of CBAM (Carbon Border Adjustment Mechanism).

Solving such a challenge is possible by stimulating businesses that implement energy-efficient solutions and modern standards for the construction of production complexes (for example, BREAM) at the expense of financial instruments (compensation of interest on loans, targeted subsidies), tax mechanisms (tax benefits for the imports or production of energy-efficient equipment and technologies) and the introduction into the regulatory framework of new, coordinated with European regulations on energy-efficient construction, standards with the appropriate confirmation and certification mechanisms.

Training programs for owners and management of enterprises, modernization of relevant training programs in the system of higher and professional education, conducting relevant communication and educational activities are also an important task for competitiveness through efficiency.

³⁷⁸ ETP Clean Energy Technology Guide

<https://www.iea.org/data-and-statistics/data-tools/etp-clean-energy-technology-guide>

One of the drivers of energy efficiency is also the desire of business owners to ensure energy security and business continuity through the development of their own generation against the background of Russian attacks on Ukraine's UES facilities.

Green chemical industry

The direction of green chemical industry is an important component for the implementation of projects of decarbonization and green transition, as research and development in this area is also necessary for the processing of waste and biomass, for obtaining biomethane and green ammonia, green products of the main chemical synthesis (synthetic gas, methanol, propylene, butylene, etc. to replace fossil raw materials).

Research in the field of green chemical industry is also necessary for low-carbon modernization of the oil production industry, extraction, storage and conversion of carbon dioxide (in particular, into biomethane), development of new solutions in the field of hydrogen technologies and energy efficiency.

Green transformation and climate adaptation of the agricultural sector

The full-scale invasion of the Russian Federation into Ukraine not only destroyed the two largest metallurgical enterprises of Ukraine (MK Azovstal PJSC and Ilyich MMK PJSC), but also caused extraordinary damage to the most significant sector of Ukrainian exports - the agricultural industry. Blocking of sea export routes, systematic attacks on grain warehouses and processing enterprises, occupation and destruction of a large part of agro-processing, seizure and mining of arable land, destruction of irrigation systems due to the explosion of the Kakhovka HPP dam, environmental crimes of the Russian occupiers led, in addition to enormous human casualties, to the loss of jobs and foreign currency inflows to Ukraine, the reduction of sales markets and the general pessimism of the owners of agricultural enterprises.

In addition to this, agricultural enterprises in the south of Ukraine suffer from climate change and are increasingly dependent on artificial irrigation of lands, suffer from abnormal climatic phenomena and the appearance of invasive species, which reduces the productivity of agricultural enterprises, increases their capital costs and limits the possibilities of attracting capital to this sector.

On the other hand, the development of bioenergy, the production of biomethane, bioethanol, the active implementation of agrovoltatics and the technology of precision agriculture and point irrigation can give Ukrainian farmers new opportunities for exports, ensure their energy self-reliance by switching vehicles and equipment for land cultivation to biofuels of their own production, reduce GHG emissions from land use and the dependence of agricultural production on artificial irrigation. Considering the capital intensity of the implementation of climate-friendly agro-innovations, an important direction in addition to research and scientific development is ensuring the availability of financing through interest compensation programs, tax incentives, grant programs at the expense of state partners and international financial organizations.

Carbon capture and storage technologies

Considering the current structure of generation and industry in Ukraine, long cycles of green transformation of the economy, rapid introduction of carbon capture, storage and processing systems are important factors of decarbonization of the economy. The existing research and technological base of CCS technologies in Ukraine is at an embryonic level, therefore, stimulation of research in this area and the introduction of relevant technologies is an important element of reducing emissions in the short term.

Artificial intelligence technologies for energy

The growth of the RES share in the Ukrainian energy mix, the development of decentralized generation, the need to implement demand-side response solutions, the spread of energy storage installations, microgrids³⁷⁹ and smart grids will require fast

³⁷⁹ Distributed generation, development of smart microgrids and systems, <https://www.kmu.gov.ua/news/rozpodilena-heneratsiia-rozvytok-rozumnykh-mikromerezh-ta-system-nakopychennia-pryskoriat-zelenyi-perekhid-v-ukraini-minenerho>

solutions that will often be unavailable to dispatchers of UES of Ukraine.

Artificial intelligence should come to the aid of human intelligence in this area, providing both frequency stability and prompt response to dynamic changes in the power system, as well as protection against cyber threats and cyber attacks on the power grid, which will remain relevant for a very long time. Supporting innovations in this area and their responsible implementation will help increase the flexibility of the energy system and create new, dynamic mechanisms for responding to challenges. In the future, the development of artificial intelligence systems for the energy industry together with new pricing mechanisms can create conditions for the active development of virtual power plant technologies and the integration of small distributed energy assets into the energy system.

Innovation leapfrogging

In Ukraine, the capacity for innovative sectors was demonstrated primarily by those sectors that were less dependent on the legacy of past investments and complex state regulation.

It is due to the fact that Ukraine practically "skipped" the stage of development of the Internet based on telephone networks and DSL technology, we have the fastest and cheapest Internet services sector in Europe.

A sufficiently high-quality education system and the absence of state regulation (and the practical absence of a domestic market) contributed to the start and rapid growth of the IT services industry, the third largest Ukrainian export industry.

The absence of the tradition of paper checks and the electronic bank clearing system created in the 1990s enabled extremely fast and cheap bank transactions and launched Ukrainian digital banks.

The transition to identity card information technologies made it possible to launch a domestic e-passport and e-passport for traveling abroad, an e-driver's license and many other electronic public services on the Unified State Web Portal of Electronic Services, the holder of which is the Ministry of Digital Transformation.

Innovation leapfrogging becomes possible in sectors where the innovation system jumps several stages of development ahead, overcoming regulatory restrictions and taking advantage of the availability of the latest solutions that have become from exclusive to massive ones.

Such an opportunity exists for the Ukrainian energy sector, because many technologies in the fields of smart grids, micro-grids, energy storage installations, renewable energy, metering systems and transmission of consumption data have been significantly improved over the last decade, and at the same time have radically fallen in price. And where the price drop is not enough, mass production of certain solutions can trigger economies of scale and reduce the cost of these innovations.

PM_RIC_WEM_04 Competitiveness of the Ukrainian economy and key industrial clusters against the background of the implementation of EU legislation in the field of energy labeling and ecodesign

Goal: mitigating the negative consequences of changing the regulatory framework

Legal basis: ESU, Law of Ukraine "On priority areas of development of science and technology"³⁸⁰, Procedure for formation of topics of scientific research and scientific and technical (experimental) developments financed from the state budget³⁸¹

Time frames: 2025-2030

Responsible bodies/organizations: Ministry of Economy, Ministry of Energy, State Energy Efficiency Agency, other stakeholders

³⁸⁰ <https://zakon.rada.gov.ua/laws/show/2623-14#n32>

³⁸¹ <https://zakon.rada.gov.ua/laws/show/13-2018-%D0%BF#n12>

Description: The adoption and bringing of technical regulations, applied in the energy sector, in compliance with the EU legislation, the adaptation of Ukrainian legislation in the field of energy labeling and eco-design to the EU law, the formation and approval of national standards, methodological recommendations for the application of technical regulations open up new opportunities for Ukrainian economy, but at the same time create significant challenges for Ukrainian manufacturers, in particular key enterprises and production clusters of traditional industries.

Changing the key standards and technical regulations governing the production of equipment, technologies and materials for the energy, construction, metallurgical, agricultural and other sectors will require Ukrainian enterprises to make significant investments in training employees, establishing production and business processes, implementing new production standards and implementing conformity assessment. In some cases, this may require a significant modernization of production facilities and a long-term shutdown of production.

Preserving the competitiveness of Ukrainian industry and mitigating economic stress from changes in the regulatory framework requires active informing of business entities about the process of change, wide deployment of educational programs and their financial support (in particular, at the expense of the state budget and international donors), financial and tax incentives for modernization production capacities of companies operating in this market.

It is also important to clearly plan the transition period between the current and new technical regulations in order to provide business entities with sufficient time for such a transition.

An effective change in the system of standards and technical regulations can create new export sectors of the Ukrainian economy and compensate for the loss of traditional markets with post-Soviet standards.

In accordance with Article 5 of the Law of Ukraine "On Priority Areas of Science and Technology Development", the Cabinet of Ministers approved a list of priority thematic areas of scientific research and scientific and technical development for the period until December 31 of the year following the termination or cancellation of martial law in Ukraine³⁸². Among them is the direction "Fundamental scientific research on the most important problems of the development of scientific-technical, socio-economic, socio-political, human potential to ensure Ukraine's competitiveness in the world and sustainable development of society and the state". Topics in this direction include, among others:

- Fundamental problems of physics, astrophysics, materials science, atomic energy and radiation safety;
- Fundamental research in Earth sciences and geocological problems, Fundamental principles of functioning and adaptation of biological systems (flora and fauna) of different levels of organization under the influence of various external factors - in fact, research in the field of adaptation to climate change;
- National interests of Ukraine in the context of geopolitical problems of the modern globalized world and the formation of a new international legal order;
- Forecasting current challenges and threats to the development of the economy and its industries in the medium and long term;
- Harmonization of the interests and needs of the individual with the social requirements on the labor market, dual education, forecasting of the qualifications and competencies required for the labor market in Ukraine in the medium and long term.

³⁸² <https://zakon.rada.gov.ua/laws/show/476-2024-%D0%BF#Text>

Relevant topics were recorded in the direction "New substances and materials" - in particular, "New resource-saving, energy-saving and environmentally safe processes for obtaining competitive substances and materials and products from them". A similar topic is included in the medium-term priority areas of innovative activity at the national level for the period until December 31 of the year following the termination or cancelling of martial law in Ukraine³⁸³.

PM_RIC_WAM_03 Active attraction of venture capital investments in climate innovation and renewable energy sector companies

Goal: creating favorable conditions for investment

Legal basis: -

Time frames: 2025-2030

Responsible bodies/organizations: Ministry of Economy, Ministry of Energy, Ministry of Environment and Natural Resources, other stakeholders

Description: The Ukrainian venture capital sector has strengthened and supported many breakthrough companies in various sectors, but its key sector of focus remains innovation in the software and IT sector. If you compare the field of energy solutions with IT, it is much more capital intensive, has longer investment cycles and is more risky due to the high level of regulation of the sector.

Today, most companies that have successfully attracted venture capital investments in the energy and climate innovation sector operate mainly in export-oriented markets. Among the Ukrainian venture funds that have investments in green startups in their portfolio are such investors as Startup Network, SMRK Venture Fund, Angel One Fund and Vesna Capital. The amount of capital and the amount of transactions in the market of IT-centric startups in Ukraine is an order of magnitude higher.

However, this trend is not unique, as the key players in the energy and climate sector in global venture capital markets are not so much traditional venture capital funds but corporate funds and accelerators. E.g., among the companies that have invested the most in green startups are such giants as Shell Technology Ventures and BP Ventures, Bright Technology Coalition / Bright Technology Ventures created by Bill Gates also actively invests in the sector, as well as Khosla Ventures of IT entrepreneur Vinod Khosla is actively working in the sector, and there are many narrowly focused funds of various sizes, such as Amazon's Cleantech Fund, Braemer Energy Ventures, Chrysalix Venture Capital, Emerald Ventures, Lowercarbon Capital, InveN Capital, Ecosummit Ventures, and others.

As for acceleration services for green startups, the global trend in this area is either the formation of corporate accelerators (such as e.On agile of the German energy giant e.On or TechX Clean Energy Accelerator, created jointly by the municipality of the Scottish city of Aberdeen and companies engaged in oil and gas production in the North Sea) or partnerships of leading accelerator networks with corporate partners (e.g. the creation of TechStars Energy in cooperation with the Norwegian corporation Equinor or the RockStart Energy Program together with Shell, Orsted, Alliander and CEZ Group).

Taking into account the leading world experience, the development of venture financing for the energy sector is possible on the basis of existing mechanisms, e.g. the creation of profile grant programs of the Ukrainian Startup Fund, which operates at the pre-seed stage, as well as the stimulation of the creation of corporate programs for the development of innovations in the energy sector and the launch of corporate accelerators by Ukrainian businesses, and the active involvement of international venture capital funds and accelerators focusing on climate and energy in Ukraine.

³⁸³ <https://zakon.rada.gov.ua/laws/show/1056-2016-%D0%BF#Text>

PM_RIC_WAM_04 Development of exports of climate and renewable energy technologies

Goal: development of competitive power equipment production

Legal basis: NES, ESU

Time frames: 2025-2030

Responsible bodies/organizations: Ministry of Economy, Ministry of Energy, other stakeholders

Description: Program documents of the government of Ukraine envisage the transition to domestic production of technologies and equipment for energy, from transformers to elements of wind farms and floating platforms of wind power plants. This ambitious task requires significant capital raising and an effective public-private partnership. Considering the state of many enterprises in the energy sector, the obsolescence of many technological developments and the production assets, the effective development of competitive production of energy equipment is possible on the condition that:

- Development of enterprises is focused on both domestic and export markets;
- Using a base of technologies and standards that are compatible with the requirements of EU regulations and other potential markets;
- Insurance of military risks and introduction of special security standards for such enterprises (in particular, inclusion in the list of CIF and the creation of areas of enhanced protection by air defense systems);
- Involvement of leading international concerns in the organization of such productions in Ukraine;
- Introduction of modern standards of corporate governance for state-owned enterprises, their rehabilitation and restoration of profitability;
- Privatization of state-owned enterprises, the restoration of which has lost its feasibility due to the suspension of production and technological delay.

Since the government's program documents also allow us to conclude about the need to design such equipment in Ukraine, it is necessary to provide training programs for relevant specialists and modernization of educational programs for power equipment engineers, attracting foreign specialists and licensing the technologies of leading international manufacturers for production in Ukraine.

The speed of launching and scaling up of such production will be a priority for the recovery of the energy sector of Ukraine, which in some cases will require unpopular solutions: the creation of new modern flexible ones instead of attempts to revitalize the giants of the past.

PM_RIC_WAM_05 Promoting the competitiveness of SMEs through green transformation and access to new markets

Goal: increasing the competitiveness of small and medium-sized enterprises (SMEs) and the ability to integrate climate-friendly products into supply chains

Legal basis: NES, the Strategy for the Development of Industrial Parks for 2023-2030³⁸⁴, the draft Strategy for the Recovery, Sustainable Development and Digital Transformation of Small and Medium Enterprises for the Period until 2027³⁸⁵

³⁸⁴ <https://zakon.rada.gov.ua/laws/show/176-2023-%D1%80#Text>

³⁸⁵ <https://www.me.gov.ua/Documents/Download?id=271105ad-b22c-4adf-9076-7c1b48453df9>

Time frames: 2025-2030

Responsible bodies/organizations: Ministry of Economy, Ministry of Finance, other stakeholders

Small and medium-sized enterprises are among the most dynamic players of the Ukrainian economy in terms of creating new jobs and developing new products and services. However, SMEs are also quite vulnerable to war and post-war challenges, so they need measures to support competitiveness and economic incentives.

Considering the challenges faced by the Ukrainian economy in the context of the Russian Federation's full-scale invasion of Ukraine, important priorities for the preservation and development of SMEs may coincide with steps aimed at green business transformation, in particular:

- Promotion of energy security of business due to renewable sources and energy innovations, in particular energy storage systems, smart and micro-grids;
- Encouraging access to export markets that set high climate and environmental standards for entry (in particular, by CBAM) and integration into relevant supply chains through training, certification and promotional initiatives;
- Stimulating the reduction of energy consumption and emissions - in particular, through ESCO mechanisms;
- Support for technological modernization of production facilities and improvement of environmental standards of production facilities due to access to green financing, interest reimbursement programs for commercial loans, and grant programs;
- Facilitating the implementation of technological regulations in the field of energy, emissions and climate provided for by the EU regulatory framework and the development of relevant capacities in the SMEs sector;
- Increasing resource efficiency and implementing circular economy principles;
- Development of industrial symbiosis models based on industrial parks and cluster mechanisms;
- Development of joint production and technological infrastructure for joint use of technological resources by small and medium-sized businesses.

Among the tools and measures that can support the development of SMEs, in parallel with the decarbonization of the economy, in particular the reduction of GHG emissions per unit of GDP:

- Development of financial products aimed at supporting the green transition of small and medium-sized businesses, their implementation of energy- and resource-efficient production technologies. In addition to green loan products, leasing products, refinancing of existing loans and focused grant programs for SMEs can also be effective in this area. An important factor is the maximum simplification of the procedures of such financial programs, the digitalization of all processes and the shortest decision-making time.
- Development of business infrastructure for SMEs in the form of eco-industrial parks³⁸⁶, due to which small and medium-sized businesses will be able to gain access to technologies, best practices and financing, and reduce environmental damage from their activities³⁸⁷.

³⁸⁶ Eco-Industrial Parks: Creating Shared Prosperity And Safeguarding The Environment, UNIDO, 2016
https://downloads.unido.org/ot/42/49/4249024/UNIDO_EIP-brochure_high-res_15June.pdf

³⁸⁷ Regional policies and eco-industrial development: The voluntary environmental certification scheme of the eco-industrial parks in Tuscany (Italy)., Journal of Cleaner Production · April 2015
<https://www.researchgate.net/publication/275634947>

The creation of eco-industrial parks corresponds to the Strategy for the Development of Industrial Parks for 2023-2030, and a favorable regulatory framework in the field of energy can help industrial parks provide resident businesses with electricity at the expense of their own generation, in particular from RES³⁸⁸.

- The formation of national and regional circular economy strategies, which will contribute to the construction of sustainable processing chains in various sectors of the economy and will reduce the damage to the environment from production waste and a long logistical arm.

The combination of such tools and measures will help both to reduce GHG emissions and waste accumulation, and to increase the depth of processing of raw materials in a unit of final products, which is provided for by NES.

ii. Where applicable, cooperation with other Contracting Parties and/or Member States of the European Union in this area

See above (section 3.5.i), in particular PM_RIC_WAM_01 Development of corporate and international partnerships in the energy and climate sector.

iii. Where applicable, financing measures in this area at national level

Today, several grant programs for supporting enterprises creating and implementing climate and energy innovations are implemented in Ukraine at the expense of international donors and international financial organizations. Among such programs is the EU-funded EBRD project "Climate Innovation Vouchers", USAID program "Competitive Economy of Ukraine", European Innovation Council project "Seeds of bravery" and others.

These programs and projects provide significant assistance to Ukrainian small and medium-sized enterprises, however the scale of support they provide is not attractive for large enterprises due to funding limitations (up to 50,000/100,000 EUR) and significant efforts to administer such grants.

An increase in the amount of grant support in this area is possible due to the expansion of the possible pool of donors, attracting co-financing from the state budget, as well as reducing business expenses through the mechanisms of subsidizing the lease of state property, the creation and access to technology and equipment parks, equipment leasing, and other grantor support tools for such programs.

Another important instrument for the development of enterprises in the energy sector, which contribute to decarbonization and green transition, can be financial innovations in the field of green banking and the formation of appropriate financial products (credit, leasing, export) with the involvement of financing from IFIs in order to increase the availability of financing and reduce the cost of capital.

In particular, see above (section 3.5.i), PM_RIC_WEM_02 Availability of grant funding for scientific research in the field of renewable energy and climate innovation, PM_RIC_WAM_02 Expansion of funding for scientific research in the field of renewable energy and climate innovation, PM_RIC_WEM_03 Development of corporate investments in the purchase of climate technologies and renewable energy solutions.

³⁸⁸ Industrial parks in Ukraine: state regulation and development, The Page, May 3, 2023 .
<https://thepage.ua/ua/experts/industrialni-parki-mozhut-stati-osnovoyu-dlya-pislyavoyennoyi-vidbudovi>

SECTION B. ANALYTICAL BASIS

4. CURRENT SITUATION AND PROJECTIONS WITH EXISTING POLICIES AND MEASURES

4.1. Projected evolution of main exogenous factors influencing energy system and GHG emission developments

The Russian Federation's full-scale invasion of Ukraine caused significant damage to the country's economy, leading to population migration, the destruction of industrial infrastructure, a corresponding drop in business activity, and obviously caused high uncertainty about the path of post-war recovery. The current state of the economy remains largely unknown, as most statistics are unavailable. In general, energy demand is determined by macroeconomic factors such as gross domestic product (GDP), industry output or value added, population, and others.

Meanwhile, due to the lack of current information and the high level of uncertainty, the prospective dynamics of the energy demand factors discussed below cannot always be properly estimated using traditional approaches, but must mainly rely on assumptions and indirect information from open sources.

i. Macroeconomic forecasts (GDP and population growth)

Since 2014, Ukraine's economy has been operating under the conditions of a hybrid war of the Russian Federation against Ukraine. But the unprovoked full-scale invasion of the Russian Federation into Ukraine, which began in 2022, became a new test of the strength and stability of Ukrainian society and economy. In addition to the death and destruction Ukraine is experiencing, the economy has had to adjust to:

- large-scale population migration and a decrease in purchasing power;
- significant narrowing of logistics routes, narrowing of the economic activity of enterprises, including export-oriented;
- significant shortage of electricity in certain periods and blackout schedules introduced in October 2022 - early 2023, during the spring of 2024;
- an increase in defense spending, which led to an expansion of the state budget deficit to UAH 914.9 billion in 2022;
- suffered huge losses as a result of Russian aggression, estimated at trillions of hryvnias.

However, the successes of the defense forces of Ukraine, the coordinated work of the Government and business, the indomitable spirit of the population, the speed of restoration of destroyed and damaged objects of critical infrastructure, as well as systematic financial support from international partners made it possible to maintain economic stability. As a result:

- the drop in GDP turned out to be significantly less than expected and amounted to 29.1% (at the beginning of the full-scale invasion of the Russian Federation into Ukraine, estimates varied between 40-50%);
- the increase in consumer prices also turned out to be less than expected at the beginning of the full-scale invasion of the Russian Federation into Ukraine and relatively comparable to the change in prices in a number of European countries, and amounted to 26.6% (annualized);
- business quickly adapted to the difficult conditions and returned to work after the suspension in February-March 2022 of almost 86.1% of enterprises.

So, despite all the difficulties and challenges, the economy in the conditions of military operations managed to maintain relative macroeconomic and price stability, to overcome the large-scale stoppage of production and the consequences of the outflow of labor resources caused by the movement to safe places.

The macroeconomic forecast of NECP is based on the Forecast of the economic and social development of Ukraine for 2024-2026 and the assumptions of the macroeconomic scenarios of the

Plan of Ukraine until 2033, which were extrapolated to 2050 by the experts of the IEP of the National Academy of Sciences of the National Academy of Sciences (Table 4.1.).

Table 4.1. Macroeconomic forecast: annual average GDP growth rates by sector, %

	2022	2023-2025	2026-2030	2031-2040	2041-2050
Agriculture, forestry and fisheries	-25.2	0.9	5.3	1.4	0.5
Mining industry	-33.2	7.5	1.8	0.8	0.1
Processing industry	-42.2	5.7	6,7	6.1	4.1
Supply of electricity, gas and steam	-32.5	5.8	4.9	1.9	1.3
Construction	-66.9	17.8	15.0	12.5	3.1
Wholesale and retail trade; repair of cars and motorcycles	-32.2	5.8	5.4	4.6	2.6
Transport, warehousing, postal and courier activities	-40.5	2.1	5.7	4.5	2.5
Other types of economic activity	-14.3	4.9	4.6	4.2	2.8
GDP	-28.8	5.0	5.4	4.6	2.8

Source: Ministry of Economy, State University "Institute of Economics and Forecasting of the National Academy of Sciences of Ukraine"

Macroeconomic scenarios determine the perspective structure of the economy, the corresponding volumes of energy use and GHG emissions, and also establish the conditions for demographic development.

At the beginning of 2022, the population of Ukraine was 41.2 million people (excluding the temporarily occupied territory of the Autonomous Republic of Crimea and the city of Sevastopol) or about 37.3 million people (excluding the temporarily occupied territories of the Autonomous Republic of Crimea, Donetsk and Luhansk regions) from a tendency to constant reduction.

For the purposes of NECP, the latest available demographic forecast of the Institute of Demography and Social Research of the National Academy of Sciences of Ukraine was used, taking into account the available official statistics and the assumptions used for the macroeconomic forecasts described above. For this, special assumptions were made regarding life expectancy, mortality rate, fertility rate (number of children per woman), number of survivors, probability of death, number of children born alive, migration and other standard demographic parameters by age and sex. The obtained results are shown in the table. 4.2, which also provides a forecast of the number of households, taking into account that the size of an urban household is 2.9 people, and a rural household is 2.7.

Table 4.2. Demographic and sectoral forecast

	2022	2025	2030	2035	2040	2045	2050
Number of population, million	37.3	30.4	34.5	33.5	32.4	31.3	30.1
Share of urban population, %	69.7	67.9	71.4	70.7	70.0	69.4	68.8
Forecast of the number of households, million	13.9	11.8	13.5	13.1	12.6	12.2	11.7
Added value in industry, billion UAH 2021	435	589	824	1183	1621	1976	2267
Added value in agriculture, billion UAH 2021	444	456.1	589.2	650.4	673.5	690.4	704.4
Added value in the commercial sector, billion UAH 2021	2060.7	2400	3025	3780	4593	5392	6016
Passenger circulation, billion pas·km	25.5	27.3	40.1	55.5	73.8	92.7	106.0
Freight turnover, billion t·km	166.8	176.2	214.0	255.9	298.6	336.5	370.3

Source: Institute of Demography and Social Research of the National Academy of Sciences of Ukraine, State Statistics Service, State University "Institute of Economics and Forecasting of the National Academy of Sciences of Ukraine"

ii. Sectoral changes expected to impact the energy system and GHG emissions

The reconstruction of destroyed infrastructure facilities (transport, energy), housing and social infrastructure, as well as the development of the defense-industrial complex (ODC) will become the main security priorities of Ukraine in the medium term. Accordingly, investments will be directed to both construction and equipment (military-industrial complex, energy projects, etc.), which will stimulate the development of construction, the production of domestic machine-building products, as well as the purchase of imports for investment purposes.

On the demand side, the driver of growth will be investment demand as a result of the implementation of production and infrastructure development projects and the gradual reconstruction of the affected areas. Although this component will continue to take a leading position among other components of demand in terms of growth rates, these rates will not be sufficient to restore most of the damaged production facilities and infrastructure and modernize production in the coming years.

Regarding the dynamics of the main components of GDP from the supply side in the short term, the following is forecast:

- The positive dynamics of the service sector will continue, which is sensitive to the activity of the population and, given its mobility and the significant level of IT use, is more autonomous, as well as quite agile and flexible to the needs of consumers, which opens up not only domestic sales markets. Its further development will be aimed at expanding the arsenal of services provided with the help of digital platforms (including to EU markets) thanks to the improvement of existing or the implementation of the latest marketing development strategies, the search for opportunities to diversify the market offer, and the creation of new virtual products and services.
- At the same time, the recovery of industrial production will take place. In the near future, the key task will remain the development of effective means, methods and technologies in the field of security and defense planning to meet the priority needs of the Ukrainian army, which will stimulate the further development of mechanical engineering. The extractive industry will also recover relatively quickly and stably, taking into account the achievement in the perspective of maximum production autonomy in order to create a solid foundation for recovery during the post-war period, which will make it possible to gradually make up for the reduced potential over a long period of decline.

- There will be an active recovery of enterprises of the food and chemical industry, textile production, since their activities are related to the satisfaction of primary needs and they are mostly representatives of small and medium-sized enterprises, which are more mobile and have wider opportunities to maneuver with logistics and sales of their products. It will be most difficult for large industrial enterprises, in particular metallurgical enterprises, some of which have been destroyed. It is not so easy for such enterprises to reconfigure logistics, move their production facilities, and their restoration or the creation of completely new modern production facilities will require a longer period.
- The development of the domestic agro-industrial complex in the forecast period will take place in the context of ensuring food security and keeping the country in the world agricultural rankings as a leading exporter of agricultural products.
- The need for rapid restoration of infrastructure (roads, bridges, communications), industrial, social and residential facilities that have suffered significant destruction or were completely destroyed during hostilities will require active investment in the field of construction against the background of maintaining the level of defense spending, which will contribute to its further development.
- The gradual intensification of economic processes will also support the transport sector, the activity of which in most subspecies was both stopped during martial law and significantly damaged as a result of enemy attacks. The development of the transport sector will be facilitated by prioritizing the restoration of transport infrastructure and the development of new alternative transport routes as key logistics channels for the supply of products to international markets. The forecast of total passenger and freight traffic is given in table 4.2. At the same time, if the passenger turnover of railway and road transport grows to the same level with a faster growth of railway transport, then the freight turnover of railways at the same time with a faster growth reaches a much higher level - 270 billion t·km against 100 billion t·km of road freight transport.
- The growth of private consumption and production activity, the establishment of logistics connections will stimulate the development of trade.

Thus, taking into account all factors on the demand side and production capacity, the 2023 GDP growth rate of 5.3% could be maintained until 2030, with a gradual slowdown to 3%-4.5% in the longer term.

iii. Global energy trends, international fossil fuel prices, EU ETS carbon price

Assumptions about world fuel prices

The forecast of import prices of the main types of energy resources for Ukraine is based on the price forecast of the International Energy Agency (World Energy Outlook 2023, Announced Pledges Scenario) ³⁸⁹ (Table 4.3). As can be seen from the table below, prices for all carbon-intensive energy resources will decrease, albeit at a small pace, but not compared to the crisis year of 2022.

³⁸⁹ World Energy Outlook 2023 // International Energy Agency. Available from : <https://www.iea.org/reports/world-energy-outlook-2023>

Table 4.3. Forecast of world prices for energy resources

	Unit	2010	2022	2030	2050
Coal	USD/t	122	290	68	53
Crude oil	USD/bbl	103	98	74	60
Natural gas	USD/MMBtu	9.9	32.3	6.5	5.4

Source: International Energy Agency

Carbon pricing assumptions

Assumptions about the price of GHG emissions differ depending on the scenario. Thus, under the “with existing policies and measures” (WEM) scenario, the tax rate for CO₂ emissions remains at the level of UAH 30/t during the martial law regime and potentially for some time after it (up to and including 2025). It is expected that indexation of all taxes, including the tax on CO₂ emissions, will be carried out approximately from 2026. Accordingly, the tax rate for CO₂ emissions will increase slightly and will amount to about 1 EUR/t by 2050. However, it is assumed that in the longer term, there will be a reform of the CO₂ tax (currently under development), which will include a review of the tax rate and base. Therefore, it is expected that the application of the tax will be extended³⁹⁰ to the sectors of transport, agriculture, as well as residential and commercial sectors.

In addition, from 2026, it is also planned to introduce the National GHG Emissions Trading System in a test mode. However, it is expected that the framework conditions for the functioning of the ETS in Ukraine will gradually approach the EU ETS. The introduction of the CBAM mechanism by the EU will additionally stimulate Ukraine to speed up the process of introducing the national ETS and harmonize it with the EU ETS. Therefore, it is assumed that the price of CO₂ emissions (the cumulative effect of the tax on CO₂ emissions and ETS) on the domestic market will constantly increase until 2050. However, given that as of 2024, a full-scale war has been going on for the third year, a large part of the industrial sector has been destroyed, the poverty level of the population has increased significantly, a rapid increase in carbon prices to the level of the EU ETS already in 2030 is unrealistic, because it will take time to recover for the economy and population of Ukraine from the war and adapt to the significant increase in energy and carbon prices. Therefore, it is assumed that the growth trajectory of the price for CO₂ emissions in Ukraine will lag behind the price on the European carbon market, which is currently about 65 EUR/t CO₂, while a year ago it was about 100 EUR/t CO₂³⁹¹.

At the same time, the scenario of "announced commitments" of the International Energy Agency (IEA)³⁹² for developing countries (including Ukraine) with net-zero emissions commitments looks more realistic for Ukraine, but also quite ambitious. According to this scenario, an increase in the price of CO₂ emissions is expected at the level of USD 40 (or EUR 38) per ton of CO₂ until 2030 and up to USD 160 (152 EUR) per ton of CO₂ by 2050.

³⁹⁰ As of 2024, the environmental tax levied on carbon dioxide emissions is applied to GHG emissions from stationary sources of pollution, that is, effectively to the energy, industry and energy supply sectors, which are separately represented in the TIMES model.

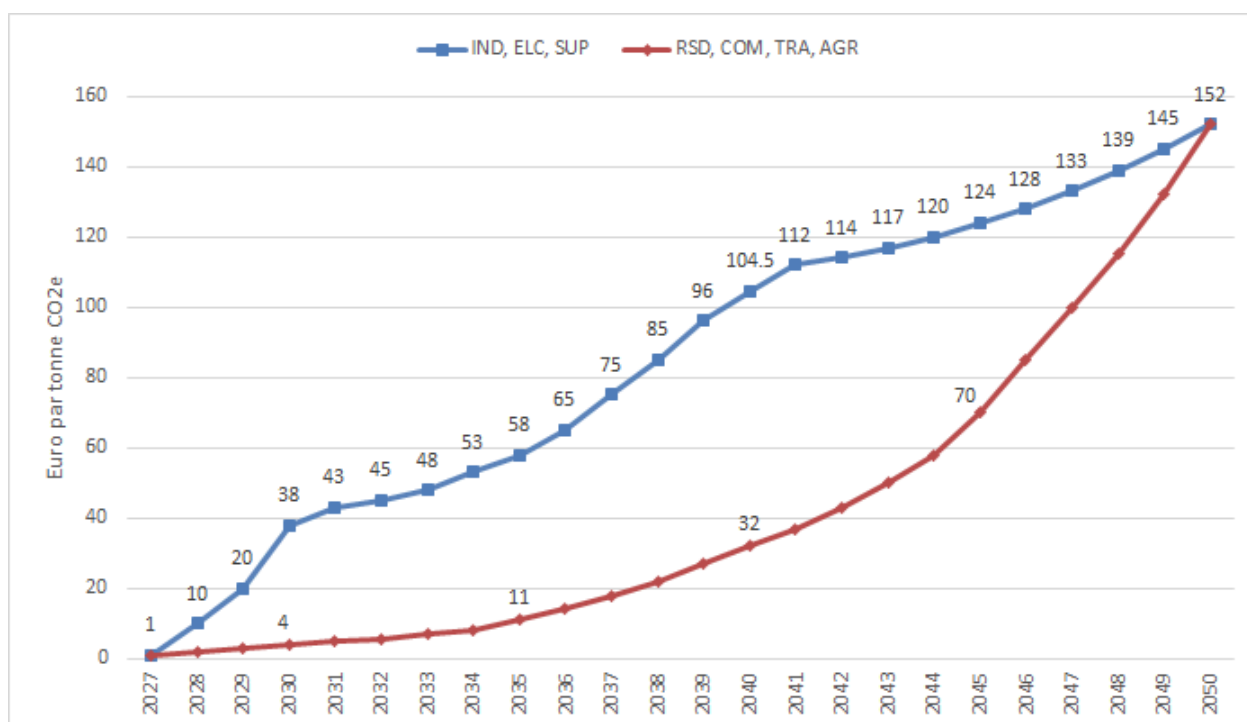
³⁹¹ <https://tradingeconomics.com/commodity/carbon>

³⁹² See Table B.2 Announced Pledges Scenario for Emerging market and developing economies with net zero emissions pledges, <https://iea.blob.core.windows.net/assets/86ede39e-4436-42d7-ba2a-edf61467e070/WorldEnergyOutlook2023.pdf>

Thus, for the modeling of the scenario "with additional policies and measures" (WAM) within the framework of NECP, in particular, for the energy, industry and energy supply sectors, an assumption is used that the price of CO₂ emissions until 2025 will be 30 UAH/t during the martial law regime, and from 2026 to 2027 - about 1 EUR/t, while in the future it will reach the levels of the above-mentioned IEA scenario, i.e. in 2030 - 38 EUR/t, in 2040 - 104.5 EUR/t, and in 2050 year - 152 EUR/t CO₂. At the same time, slower price growth is expected for other sectors (transport, agriculture, residential and commercial sectors) (see figure below).

At the same time, after the abolition of martial law, it is planned to update the NECP, which will include a review of the assumptions regarding the price of CO₂ emissions. After the launch of the national ETS and the adoption of the carbon tax reform road map, which is expected within the next two years, it will be possible to formulate a clearer vision of the development of the national carbon market and the forecast of CO₂ emissions price.

Fig. 4.1. Carbon price assumptions for different sectors until 2050, EUR/t CO₂



Source: International Energy Agency, State Institution "Institute for Economics and Forecasting of the National Academy of Sciences of Ukraine"

iv. Technology cost developments

Table D.3.1 in Annex 3 presents the key technical and economic characteristics of selected technologies for the production of electricity and thermal energy, which were used as assumptions in the modeling process underlying this NECP. Capital costs include the cost of capital, but operating costs are also included in the model.

4.2. Dimension Decarbonisation

4.2.1. GHG emissions and removals

i. Trends in current GHG emissions and removals across the economy and different sectors

According to the National Inventory of GHG emissions for 1990-2021, in 2021, total GHG emissions in Ukraine amounted to 341.5 million tons of CO₂-eq. (including LULUCF). This is 62.5% less than in 1990, but 7.5% more than in 2020.

As a result of the post-Soviet economic downturn, GHG emissions in Ukraine decreased from 911.4 million tons of CO₂-eq. (including LULUCF) in 1990 to 405 million t CO₂-eq. in 2000. Although the economy began to recover after 2000 and annual GDP growth rates were significant, GHG emissions continued to decline (see Table 4.4). This is due to the fact that the economy of Ukraine was undergoing significant structural changes, and inefficient energy-intensive sectors were partially replaced by trade, services and the financial sector. In addition, the modernization of production had a significant impact on the trends of GHG emissions, which made it possible to reduce the energy intensity of basic industrial goods.

The trend of GHG emissions in 2008-2021 was determined by the impact of the global financial and economic crisis of 2008-2009 and the temporary occupation by the Russian Federation of part of the territory of Ukraine in 2014, which largely determined commodity production in the main export-oriented industries (metallurgy, chemical industry, mechanical engineering, etc.), which, in turn, affect the supply sectors - power generation, mining industry (ore and coal mining). The recovery of the economy after the strict measures against COVID-19 in 2020 led to an increase in greenhouse gas emissions in all sectors except waste.

Table 4.4. Emissions of greenhouse gasses in 1990-2021, million tons of CO₂-eq.

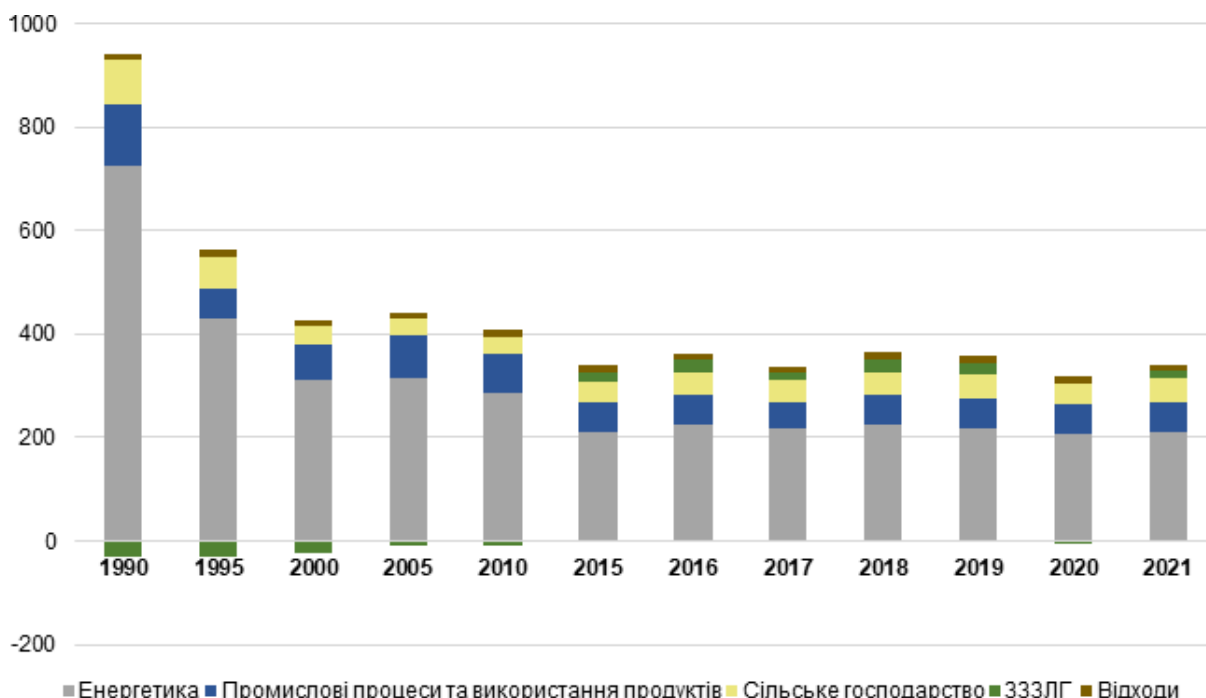
Gas	1990	1995	2000	2005	2010	2015	2016	2017	2018	2019	2020	2021	The change in GHG emissions is relative to 1990, %
CO ₂ (without LULUCF)	706.2	390.1	285.7	313.5	294.4	223.8	234.0	223.1	231.7	221.9	206.8	210.2	- 70.2
CH ₄	182.9	139.1	118.3	102.8	84.9	61.6	66.4	64.2	67.9	70.1	72.0	71.5	- 60.9
N ₂ O	53.6	33.1	24.1	25.9	27.6	33.2	36.5	35.1	39.0	40.6	38.1	43.8	- 18.4
HFC*	No	No	15.7	285.1	743.9	801.6	921.4	1049.3	1395.8	1685.0	1751.5	1901.0	100.0
PFC* . **	235.8	178.1	115.7	142.3	26.7	No	No	No	No	No	No	No	- 100.0
SF ₆ *	0.0	0.1	0.4	4.5	9.7	19.6	24.4	28.6	33.4	38.8	43.4	48.9	641194.7
NF ₃ *	No	No	No	No	No	No	No	No	No	No	No	No	-
Net CO ₂ emissions from LULUCF	- 31.6	- 32.4	- 23.2	- 9.3	- 9.2	19.5	24.2	13.3	24.7	23.1	- 1.1	14.0	- 144.4
CO ₂ (including LULUCF)	674.6	357.6	262.5	304.3	285.1	243.3	258.2	236.4	256.4	245.1	205.8	224.2	- 66.8
Total (without LULUCF)	942.8	562.1	427.9	442.4	407.3	319.2	337.6	323.3	339.8	334.1	318.0	327.3	- 65.3
Total (including LULUCF)	911.4	530.0	405.0	433.5	398.3	338.9	362.0	336.7	364.7	357.4	317.6	341.5	- 62.5
Total (without LULUCF), including indirect CO ₂ emissions	942.8	562.1	427.9	442.4	407.3	319.2	337.6	323.3	339.8	334.1	318.0	327.3	- 65.3
Total (including LULUCF), including indirect CO ₂ emissions	911.4	530.0	405.0	433.5	398.3	338.9	362.0	336.7	364.7	357.4	317.6	341.5	- 62.5

Notes: * emissions are indicated in thousand tons of CO₂-eq.

** no PFC emissions, as refrigerants containing gas were not imported in 2011-2021.

The energy sector is the largest source of national GHG emissions, accounting for 64% of the total, while the industrial process and product use sector and agriculture (see detailed description of emissions in the agriculture sector in Annex 2) contribute 18% and 14%, respectively. As can be seen from Figure 4.2, the LULUCF sector has evolved from a net sink to a net emitter of greenhouse gas emissions over the period 1990-2021.

Fig. 4.2. Trends in GHG emissions and absorption during 1990-2021, million tons of CO₂-eq.



ii. *Projections of sectoral developments with existing national, Energy Community and European Union policies and measures at least until 2040 (including for the year 2030)*

The table below shows the main results of modeling and forecasting GHG emissions in Ukraine under the scenario with existing policies and measures (WEM) using the TIMES-Ukraine model.

Table 4.5. The main results of modeling in the field of GHG emissions in Ukraine according to the WEM scenario

Scenario with existing policies and measures (WEM)									
	1990	2015	2020	2025	2030	2035	2040	2045	2050
The total amount of GHG emissions, Mt CO₂-eq.	911	334	318						
Sectors of energy, industrial processes and product use	844	267	264	188	199	214	227	234	242
Agriculture	87	39	42	37	42	46	48	50	51
Land use, land use change and forestry*	-31	20	-0.4	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Waste sector	12	13	12	11	121	11	110	109	98
The share of GHG emissions from the level of 1990, %	100	37	35						
Sectors of energy, industrial processes and product use	100	32	31	22	24	25	27	28	29

<i>Agriculture</i>	<i>100</i>	<i>45</i>	<i>48</i>	<i>43</i>	<i>51</i>	<i>55</i>	<i>56</i>	<i>59</i>	<i>61</i>
<i>Land use, land use change and forestry</i>	<i>100</i>	<i>265</i>	<i>199</i>	<i>N.A</i>	<i>N.A</i>	<i>N.A</i>	<i>N.A</i>	<i>N.A</i>	<i>N.A</i>
<i>Waste sector</i>	<i>100</i>	<i>101</i>	<i>99</i>	<i>91</i>	<i>86</i>	<i>85</i>	<i>79</i>	<i>72</i>	<i>63</i>

Source: National Inventory of Anthropogenic Emissions from Sources and Absorption by Sinks of Greenhouse Gases in Ukraine for 1990-2021, Institute for Economics and Forecasting of the National Academy of Sciences of Ukraine.

*Notes: *Currently, it is impossible to analyze the situation in the LULUCF sector and develop a reasonable forecast of GHG emissions in this sector due to the war and the related lack of reliable data on the LULUCF sector.*

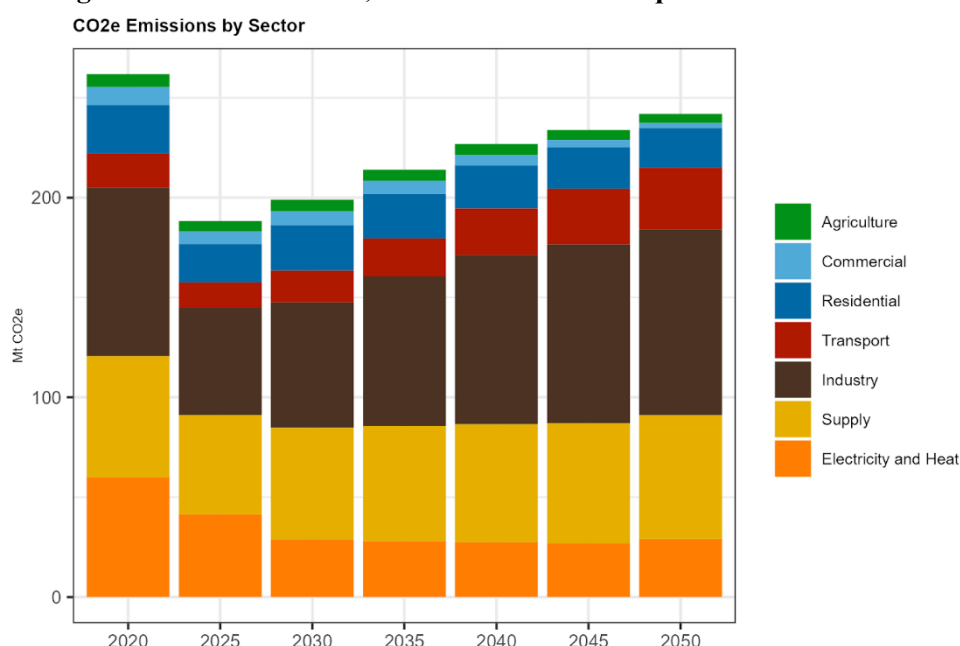
n.d. - no data.

Greenhouse gas emissions in the "Energy" and "Industrial processes and product use" sectors

The figure below shows the forecast of GHG emissions in the "Energy" and "Industrial processes and product use" sectors (in the sense of the UN Intergovernmental Panel on Climate Change (IPCC)) under the scenario with existing policies and measures (with existing measures, WEM) until 2050, obtained using the economic-mathematical model TIMES-Ukraine, which describes all energy flows in the country.

The simulation results show that the rapid recovery of the Ukrainian economy in the post-war period, without the implementation of additional energy efficiency measures and policies, the expansion of the use of renewable energy sources, other measures for decarbonization and technological modernization of the energy sector, will cause a gradual increase in GHG emissions in the "Energy" and "Industrial" sectors processes and use of products".

Fig. 4.3. Greenhouse gas emissions in the "Energy" and "Industrial processes and product use" sectors according to the WEM scenario, million tons of CO₂-eq.



Source: calculations of the Institute of Economics and Forecasting of the National Academy of Sciences of Ukraine based on the TIMES-Ukraine model

Under the conditions of the WEM scenario, GHG emissions in the specified sectors with the growth of the Ukrainian economy can be reduced by almost a quarter by 2030 compared to 2020, after which, without the implementation of additional measures, GHG emissions in the specified sectors will continue to grow until 2050. However, will not reach the 2020 level and will be 8% less than the GHG emissions in these sectors in 2020 and will be less than 29% of the 1990 level.

Greenhouse gas emissions in the "Agriculture" sector

The assessment of greenhouse gas emissions in the agriculture sector to develop GHG projections is carried out in line with the methodological recommendations "Guidelines for national greenhouse gas inventories of the Intergovernmental Panel on Climate Change (IPCC)"³⁹³. Key factors of agricultural activity served as drivers for the projection.

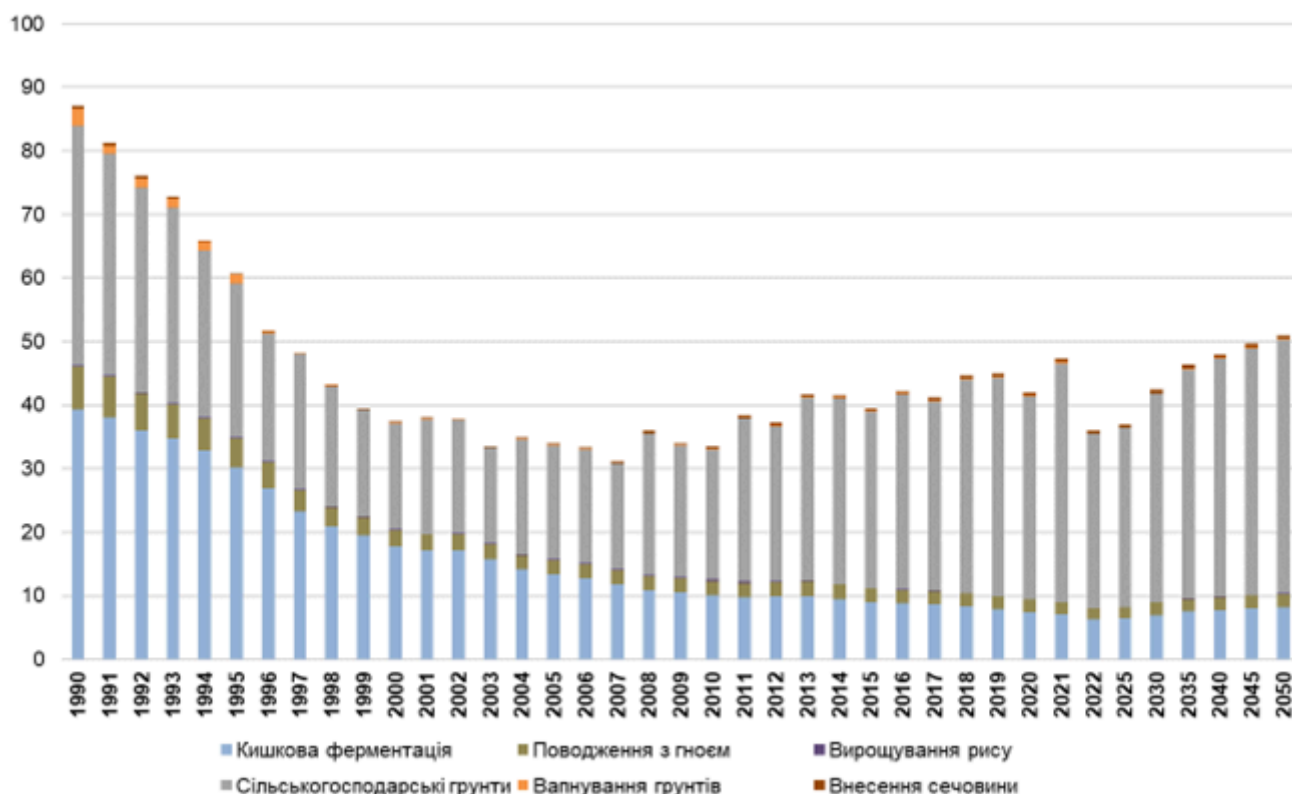
The indicators of key factors as of 2030, 2040, and 2050 agreed by the Ministry of Agriculture were developed taking into account a set of conditions (Appendix 2), namely: cessation of hostilities (both currently active and further confrontation with periodic escalation); restoration of means of agricultural activity (reconstruction of destroyed/damaged livestock farms; demining of pastures, hayfields, arable and other lands; restoration/replenishment of the mechanized component of agricultural activity, etc.); restoration of the number and resettlement of the population (migration from abroad; return to places of residence before the start of the full-scale invasion of the Russian Federation in Ukraine; accommodation of temporarily displaced persons in new places of residence; natural population growth, etc.); quality of demographic policy; the level of domestic demand for agricultural products; export possibilities of agricultural sector; national strategy for post-war reconstruction and development of agriculture.

³⁹³ <https://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html>

The assessment of greenhouse gas emissions in various areas of agricultural activity in accordance with the projected initial data (Fig. 4.4) indicates that GHG emissions under the WEM scenario in the sector will amount to 42.4 million t CO₂-eq, 48 million t CO₂-eq and 51 million t CO₂-eq in 2030, 2040 and 2050, respectively.

Therefore, the WEM scenario, which is based on the current (limited) level of implementation of the current legislation, which assumes a significant delay between policy formulation, adoption and implementation, will ensure a small increase in greenhouse gas emissions. Compared to the base year of 1990, projected greenhouse gas emissions in 2030, 2040, and 2050 will be 48.6%, 55.1%, and 58.5%, respectively.

Fig. 4.4. Projections of emissions from agricultural sector in Ukraine according to the WEM scenario, million tons of CO₂-eq



Greenhouse gas emissions in the "Waste" sector

The WEM scenario was developed on the basis of the current regulatory and legal documents of waste management in Ukraine as of May 2024, taking into account general cross-sectoral macroeconomic and socio-demographic forecasts. This scenario assumes that by 2030, the National Waste Management Strategy in Ukraine until 2030 ³⁹⁴ and the National Waste Management Plan until 2030 ³⁹⁵ will be partially implemented. The full implementation of the above-mentioned documents will take place gradually throughout the projections period. This scenario takes into account that the goals of sustainable development in Ukraine ³⁹⁶ will be achieved by 2030, which include: reducing the share of untreated wastewater, increasing the specific consumption of food products,

³⁹⁴ <https://zakon.rada.gov.ua/laws/show/820-2017-%D1%80#Text>

³⁹⁵ <https://zakon.rada.gov.ua/laws/show/117-2019-%D1%80#Text>

³⁹⁶ <https://zakon.rada.gov.ua/laws/show/722/2019#Text>

decrease in the specific consumption of water resources per GDP, etc. It also corresponds to the implementation for the period until 2030 of the provisions of the Upof Nationally Determined Contribution of Ukraine³⁹⁷ (hereinafter - NDC) in the part of household waste (hereinafter - HW) management and takes into account the implementation of measures to implement Ukraine's climate policy within the framework of participation in the global initiative to reduce methane emissions "Global Methane Pledge"³⁹⁸. In more detail, the WEM scenario envisages a reduction in the share of household waste disposal to 70% by 2030 and to 30% in 2050; increasing the share of disposal of biogas generated at landfills to 15% in 2030 and 36% in 2050, respectively; construction of new waste composting enterprises with lower specific indicators of greenhouse gas emissions.

The following should be noted: according to the WEM scenario, in the period up to 2030, it is expected that the increase in the share of biogas disposal at household waste landfills will occur mainly due to the increase of flaring capacities, and not due to the recovery of methane to produce electricity. This is due to a number of reasons: first, the installation of biogas disposal technologies is a necessary condition for extending the operation of existing landfills, starting from January 1, 2030, according to the recently adopted Law "On Waste Management"; at the same time, biogas flaring technology is the cheapest alternative to meet this requirement. And secondly, the economic potential of biogas recovery at existing landfills as a source of useful energy at landfills of Ukraine is almost exhausted - biogas recovery facilities have already been installed at the largest landfills, and those landfills that are not yet equipped with biogas recovery facilities have a rather low level of methane flow due to the peculiarities of construction and operation in the past. Starting from 2030, the growth of biogas disposal capacities at landfills of household waste will be achieved exclusively due to the further spread of biogas recovery technologies in parallel with the development of regional landfills, where the placement of such installations will have an economic advantage over flaring due to the high level of insulation of the "body" of the newly constructed landfills and as a result, a significant flow of methane.

The methodology for the development of the WEM scenario, estimating GHG emissions and capital investments in the "Waste" sector is provided in Appendix 4.

Unfortunately, the achievement of the indicator of 30% household waste disposal (from the total volume of generated waste) in 2030 is not realistic (defined as one of the main target indicators in the National Strategy for Waste Management in Ukraine until 2030 and the National Plan for Waste Management until 2030). This is due to a number of causal processes: the full-scale invasion of the Russian Federation in Ukraine in early 2022, the adoption of the new modern Law of Ukraine "On Waste Management"³⁹⁹ 3-4 years later than expected, an unfavorable investment climate in the field of waste management in Ukraine, etc. At the same time, the implementation of the WEM scenario will ensure the necessary trend of reducing GHG emissions in the field of household waste management, which was set during the development and approval of the NDC.

The list of key policies in the field of waste management under the WEM scenario is provided in the table 4.6 below. The ways of implementing these policies in the field of waste management are defined in detail in the National Waste Management Plan until 2030.

³⁹⁷ <https://zakon.rada.gov.ua/laws/show/868-2021-%D1%80#Text>

³⁹⁸ <https://zakon.rada.gov.ua/laws/show/607-2023-%D1%80#Text>

³⁹⁹ <https://zakon.rada.gov.ua/laws/show/2320-20#Text>

Table 4.6. Key policies and measures in the Waste sector under the WEM scenario

No	The name of the key policy	Quantitative indicator		
		2021/2022 (statistical information)	2030	2050
1	Disseminating the practice of household waste components reuse	1.5%* (a, 2022)	8%* (full implementation of current policies and measures)	10%*
2	Disseminating the practice of household waste recycling	5.5%* (a, 2022)	10%* (partial implementation of current policies and measures)	34%*
3	Disseminating the practice of household waste organic components composting	1.2%* (a, 2022)	5%* (partial implementation of current policies and measures)	16%*
4	Disseminating the practice of thermal treatment of household waste (with obtaining useful energy)	1.7%* (a, 2022)	7%* (partial implementation of current policies and measures)	10%*
5	Increasing the amount of disposal (recovery and flaring) of landfill biogas at landfills	9.2%** (b, 2021)	15%** , of which: 9% – recovery; 6% – flaring (the quantitative indicator is not explicitly established by law)	36%** , of which: 30% – recovery; 6% - flaring

Notes: (a, 2022) Analysis of the state in the field of household waste management in Ukraine for 2022; according to the Ministry of Infrastructure,⁴⁰⁰; (b, 2021) National Inventory of Anthropogenic Emissions from Sources and Absorption by Sinks of Greenhouse Gasses, according to the Ministry of Environment⁴⁰¹;

* - share of the total volume of generated waste;

** - share of the total volume of methane produced.

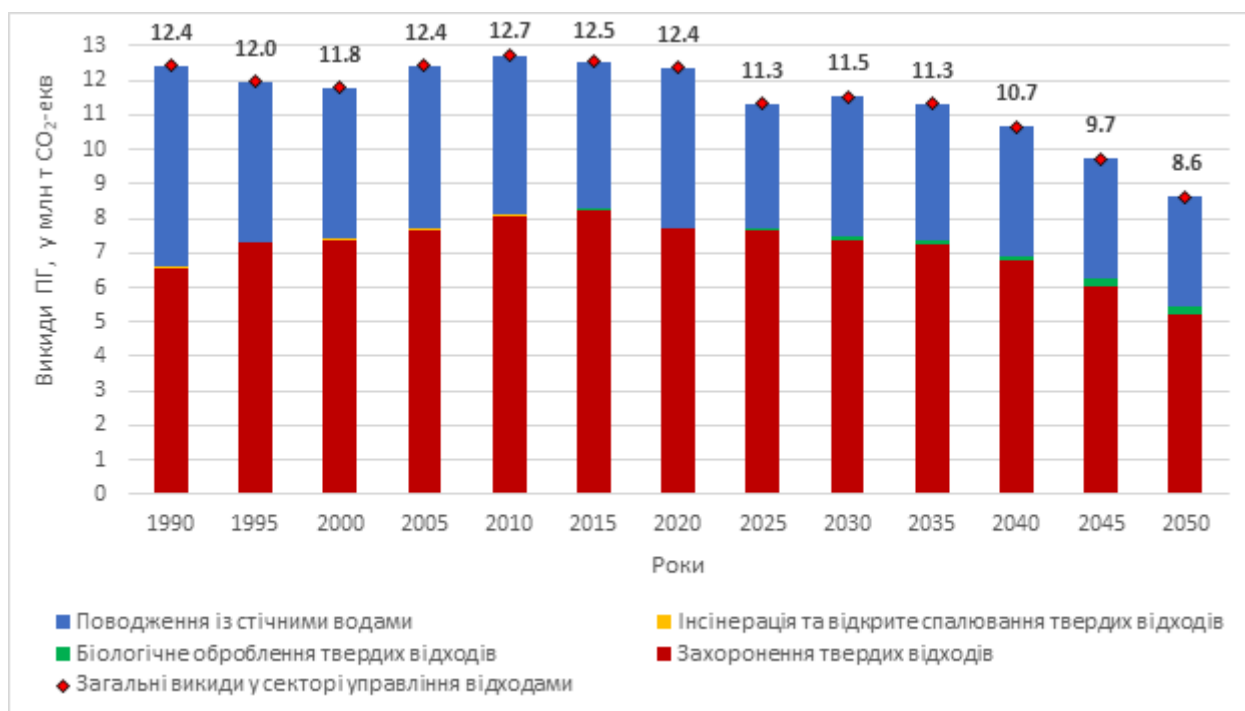
According to the WEM scenario, GHG emissions in the waste management sector will decrease moderately and reach 10.7 million CO₂-eq in 2030, which is 14% lower than the level of emissions in 1990. In the future, emissions will continue to decrease, and in 2050 they will amount to 7.9 million tons of CO₂-eq, which is 37% less than the level of 1990. Detailed GHG emissions in the waste management sector until 2050 are shown in Fig. 4.7. in the period from 2020 to 2025, they will decrease from 12.4 million tons of CO₂-eq to 11.3 million tons of CO₂-eq; or by 8.2%. During 2026-2030, total GHG emissions in the waste management sector will increase insignificantly, and will reach the value of 11.5 million tons of CO₂-eq in 2030. The expected slight increase in GHG emissions in the period from 2026 to 2030 will be due to the return of citizens from abroad, as well as the intensification of nitrification-denitrification processes at wastewater treatment facilities due to the additional increase in protein consumption by the population as a result of the improvement in the quality of life, which, accordingly will affect the increase of N₂O emissions from the handling of household wastewater.

⁴⁰⁰ <https://mtu.gov.ua/news/34323.html>

⁴⁰¹ <https://unfccc.int/documents/628276>

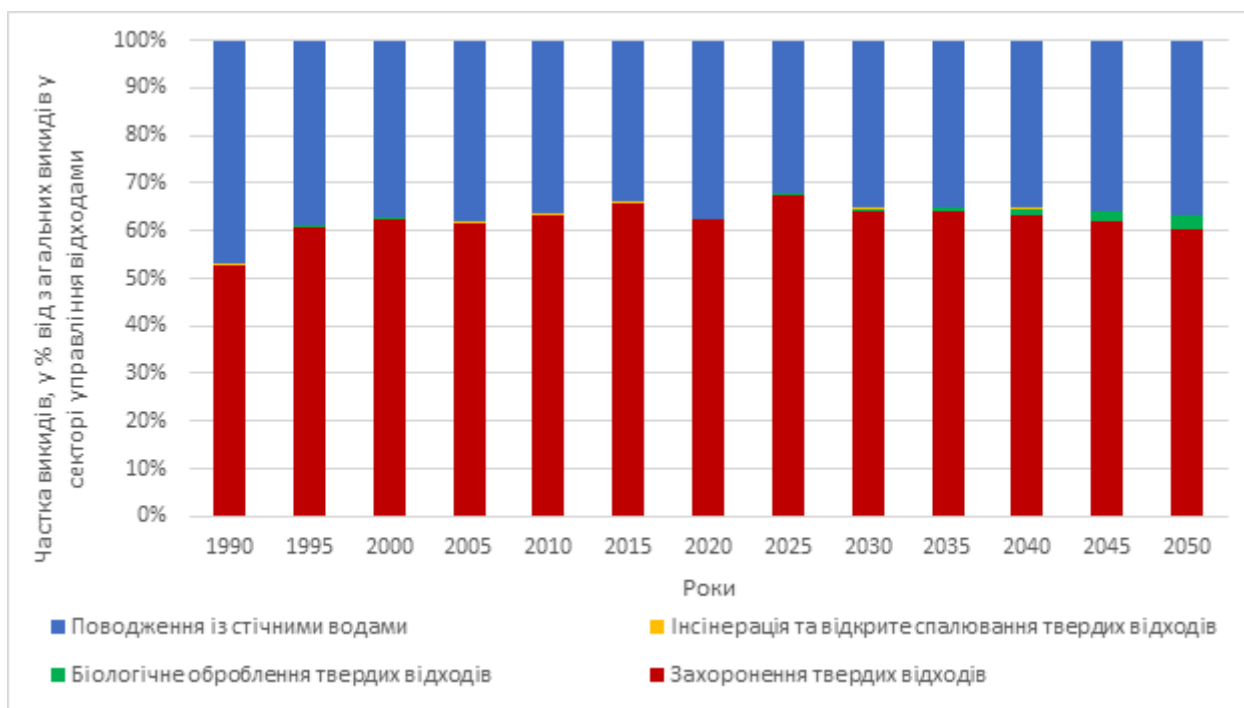
In the future, after 2030, when a peak of GHG emissions in the waste management sector is expected according to the WEM scenario, projected GHG emissions in the sector will gradually decrease, and will reach the value of 8.6 million tons of CO₂-eq in 2050, which will be 69% from the level of 1990. Detailed GHG emissions in the waste management sector until 2050 under the WEM scenario are shown in Fig. 4.5.

Fig. 4.5. GHG emissions in the waste management sector under the WEM scenario; for the period 1990-2020 - statistical data, and for the period 2025-2050 - forecast data; according to IPCC categories



Under the WEM scenario, the structure of emissions in the waste management sector does not undergo significant changes. Thus, the main source of GHG emissions in the sector will remain solid waste disposal sites, the contribution of which will be 60-67% of the total emissions in the sector, which is comparable to the corresponding indicator in 2020, when this indicator was 62%. The share of emissions related to wastewater treatment will be 32-37% (with a maximum in 2030) by 2050, which is slightly higher than the corresponding figure in 2020, when it was 38%. The only source in which a gradual increase in GHG emissions is expected is the biological treatment of solid waste, emissions from which will increase from 7.5 thousand tons of CO₂-eq. (0.1% of total emissions in the sector) in 2020 to 69.7 thousand CO₂-eq. in 2030, and will reach the value of 226.5 thousand tons of CO₂-eq. (2.6% of total emissions in the sector) in 2050. Such considerable increase in emissions from the biological treatment of solid waste will be caused by the intensive spread of the practice of household waste organic components composting, particularly: food waste and food industry waste at all stages of production and consumption, as well as waste from green spaces. At the same time, it should be noted that the practice of organic waste components composting is an effective method of reducing GHG emissions, especially if it is considered as an alternative to landfilling, because specific GHG emissions from composting the same amount of organic material are tens to hundreds times lower than the corresponding indicators of anaerobic biodegradation processes at landfills, i.e. their disposal. Greenhouse gas emissions from thermal waste treatment methods will account for 0.1%-0.2% of total emissions in the waste management sector. They are the smallest source of emissions in the sector, because they include waste treatment activities without further obtaining useful energy. The latter type of activity is included in the energy sector, where it is taken into account as the use of renewable energy sources and alternative fuels. The detailed structure of emissions by individual categories in the waste management sector until 2050 is shown in Fig. 4.6.

Fig. 4.6. The structure of GHG emissions in the waste management sector according to the WEM scenario; for the period 1990-2020 - statistical data, and for the period 2025-2050 - projections; according to IPCC categories



In the WEM scenario, the main factors that will determine trends in GHG emissions in the waste management sector are:

- a moderate reduction in the share of incineration by 2050;
- moderate deployment of biogas disposal technologies in the period up to 2030 and intensification of this process in the period up to 2050;
- intensification of nitrification-denitrification processes at wastewater treatment facilities as a result of increased protein consumption by the population.

A key risk on the way to reducing GHG emissions according to the WEM scenario is the low efficiency of biogas disposal technologies, which should be implemented at landfills with a low biogas flow rate.

4.2.2. Renewable energy

i. Current share of renewable energy in gross final energy consumption and in different sectors (heating and cooling, electricity and transport) as well as per technology in each of these sectors

In recent years, the growth of the installed capacities of renewable energy facilities has been due to the introduction of the "green" tariff model in Ukraine. Thus, as of the beginning of 2022, the total installed capacity of renewable energy facilities under the "green" tariff amounted to more than 9.5 GW (10.1 GW taking into account facilities occupied until February 24, 2022), and the amount of investments in the industry more than 12 billion US dollars. The share of "green" electricity in the energy balance of the state in 2021 reached 13.8% (with large hydroelectric power plants).

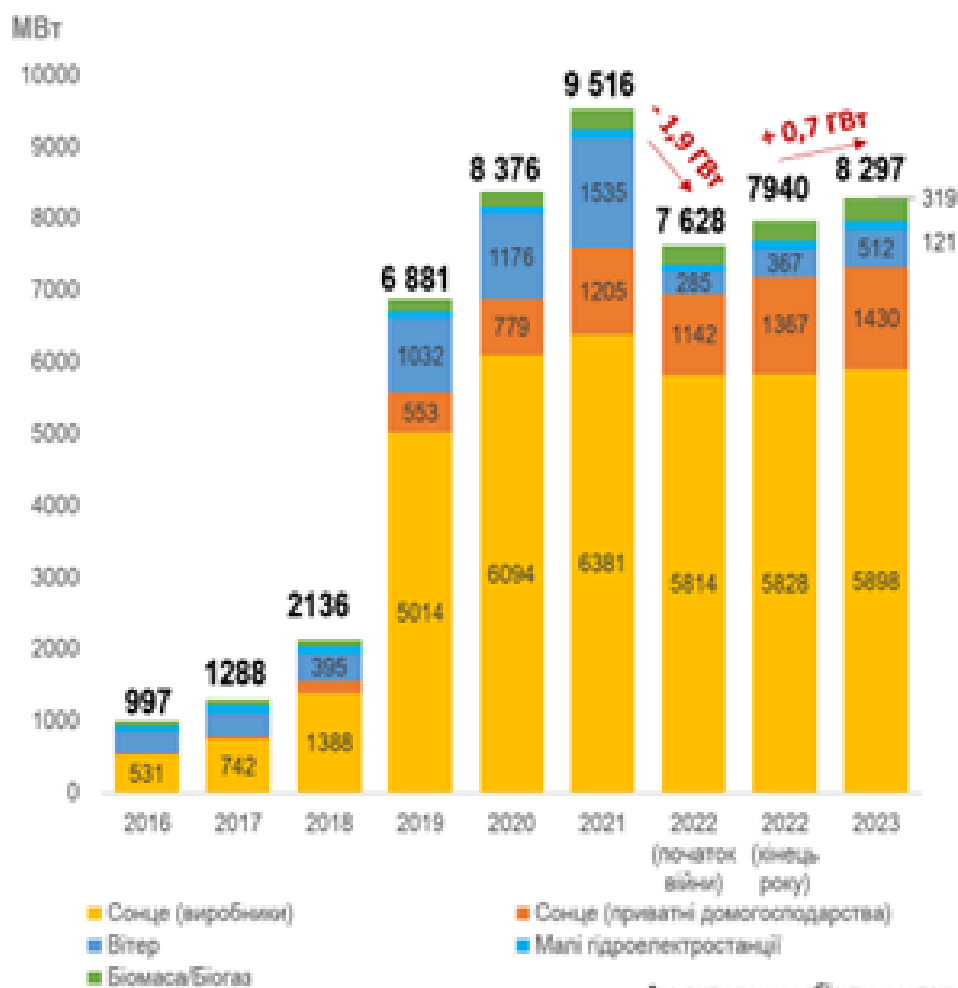
Similar to other sectors, the full-scale military aggression unleashed by the Russian Federation in February 2022 had a significant impact on the functioning of the RES industry. In particular, as a result of the invasion of the Russian Federation on the territory of Ukraine in 2022, about 25% of the installed RES capacity was occupied. The situation with wind turbines is particularly difficult - 75% or about 1.25 GW of them are located in the occupied territories of Kherson and Zaporizhzhia regions (taking into account the capacities occupied until 2022 - 1.4 GW). Also, about 14% of SPPs are in occupation, that is more than 0.6 GW. But even in such conditions, the share of RES remains significant - in 2023,

about 10% of electricity was produced by wind and solar power plants. Taking into account large HPPs, this share reached 20.3% (more than in the pre-war period).

In general, during 2022-2023, more than 660 MW of new RES capacities were launched in Ukraine. Therefore, taking into account the renewable energy generating facilities located in the occupied territories (including until February 24, 2022), the total installed capacity of renewable energy facilities in Ukraine is 10.8 GW.

In 2020, the share of RES in the structure of the total final consumption of energy resources was 8.4%. At the same time, the share of RES in the heating and cooling, power generation and transport sectors was 9.3%, 10.7% and 2.5%, respectively.

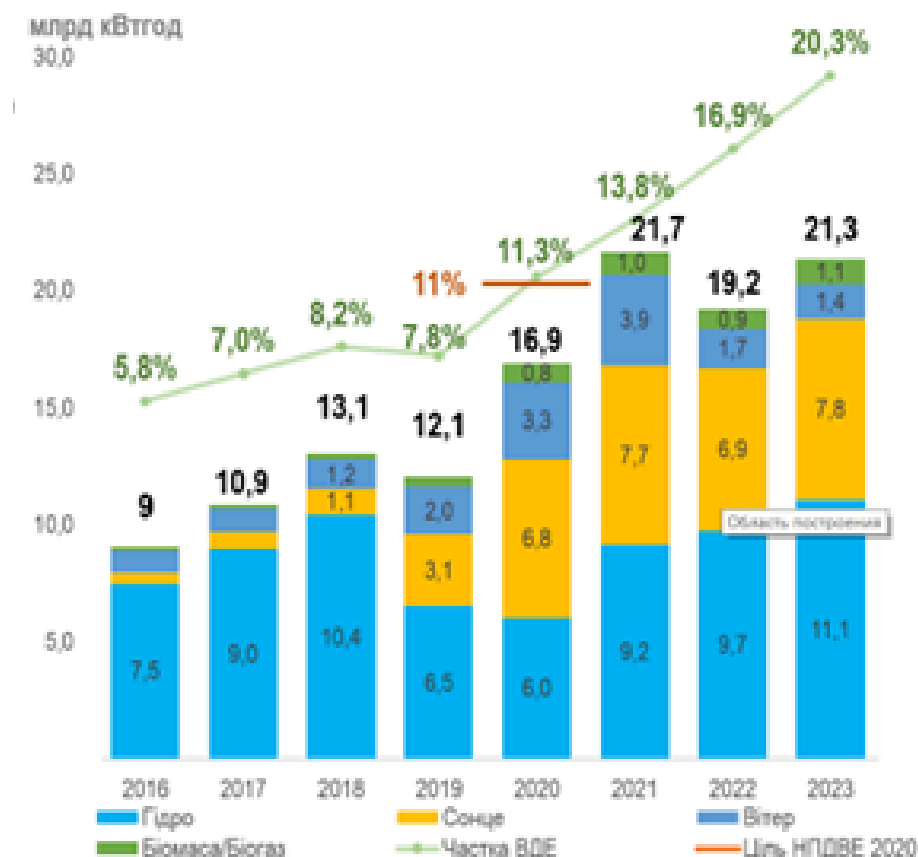
Fig. 4.7. Installed RES capacity under the "green" tariff*



Note: *Not including facilities located in temporarily occupied territories until February 24, 2022 (about 0.6 GW).

Source: Ministry of Energy.

Fig. 4.8. Production of electricity from renewable energy sources (including large hydroelectric power plants)



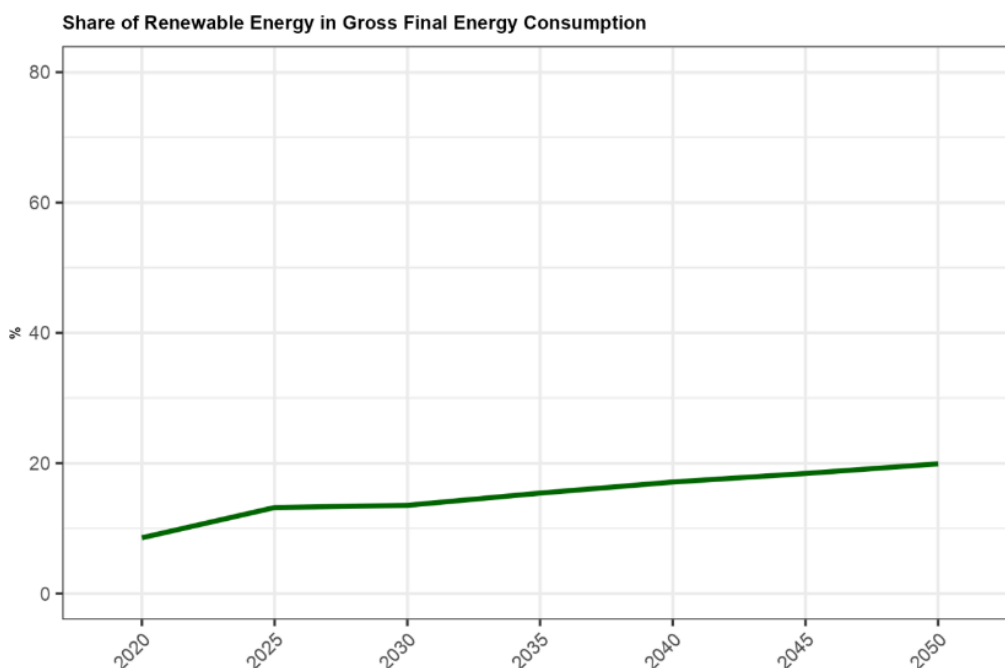
Source: Ministry of Energy.

ii. Indicative projections of development with existing policies for the year 2030 (with an outlook to the year 2040)

Considering the current and potential consequences of a full-scale invasion of Ukraine by the Russian Federation, achieving the goal of 27% RES in the structure of gross final consumption of energy resources seems extremely ambitious.

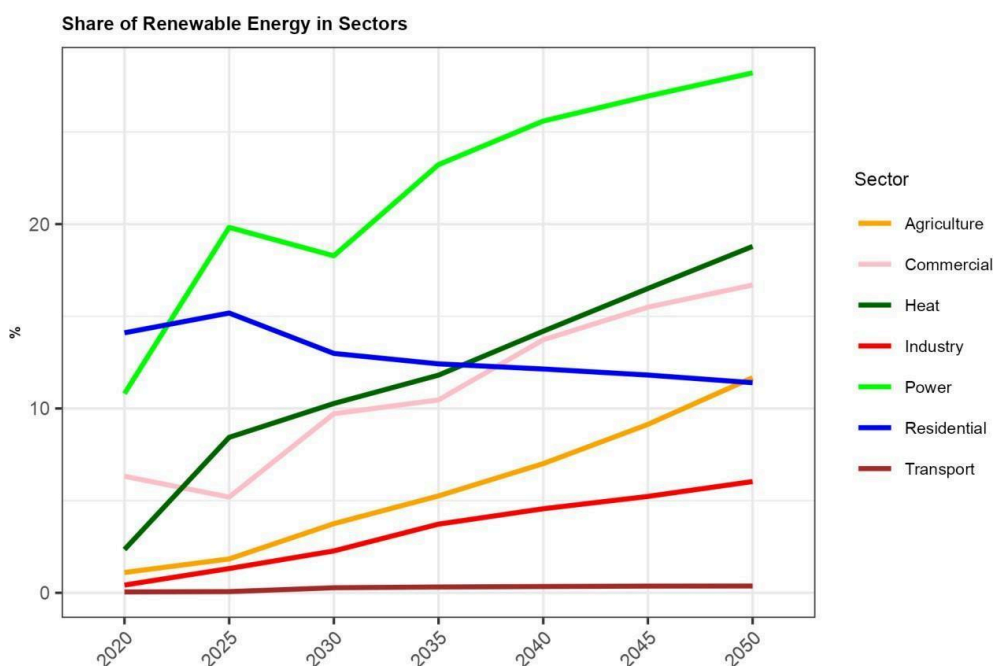
The simulation results under the WEM scenario show that the share of RES in the structure of the total final consumption of energy resources will continue to increase, but this growth will be minimal and achieving the target indicator in 2030 does not seem possible (Figure 4.9), primarily due to the low penetration of RES in the energy consumption of industry, transport, substitution of carbon-intensive energy resources and low rates of substitution of natural gas by RES in individual heating systems of the residential and commercial sectors (Figure 4.10).

Figure. 4.9. The share of RES in the total final energy consumption according to the WEM scenario, %



Source: calculations of the Institute of Economics and Forecasting of the National Academy of Sciences of Ukraine based on the TIMES-Ukraine model

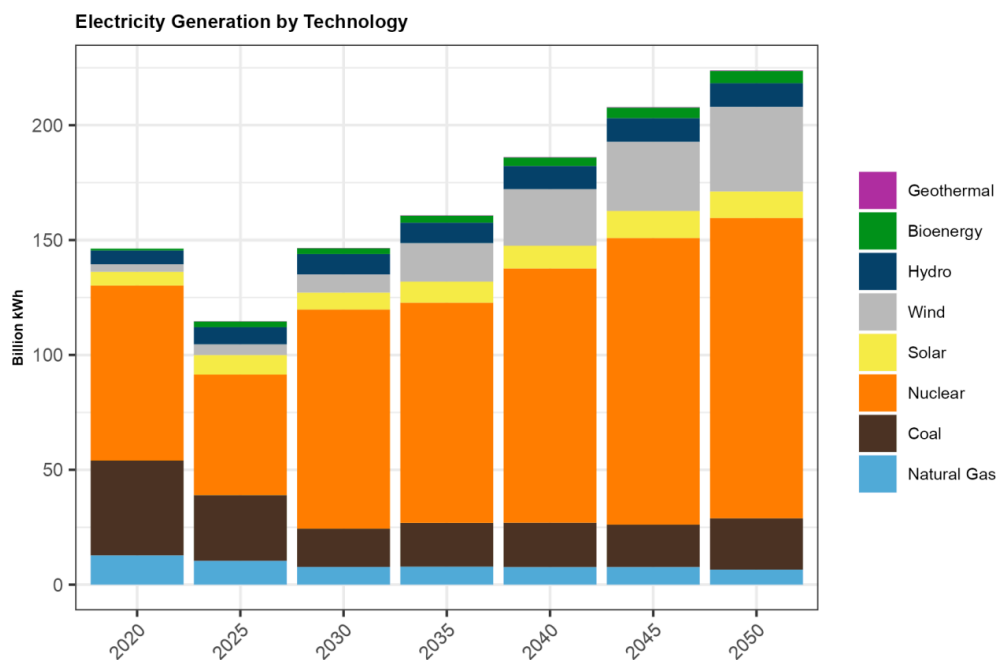
Figure. 4.10. The share of RES in the total final energy consumption according to the WEM scenario by sector, %



Source: calculations of the Institute of Economics and Forecasting of the National Academy of Sciences of Ukraine based on the TIMES-Ukraine model

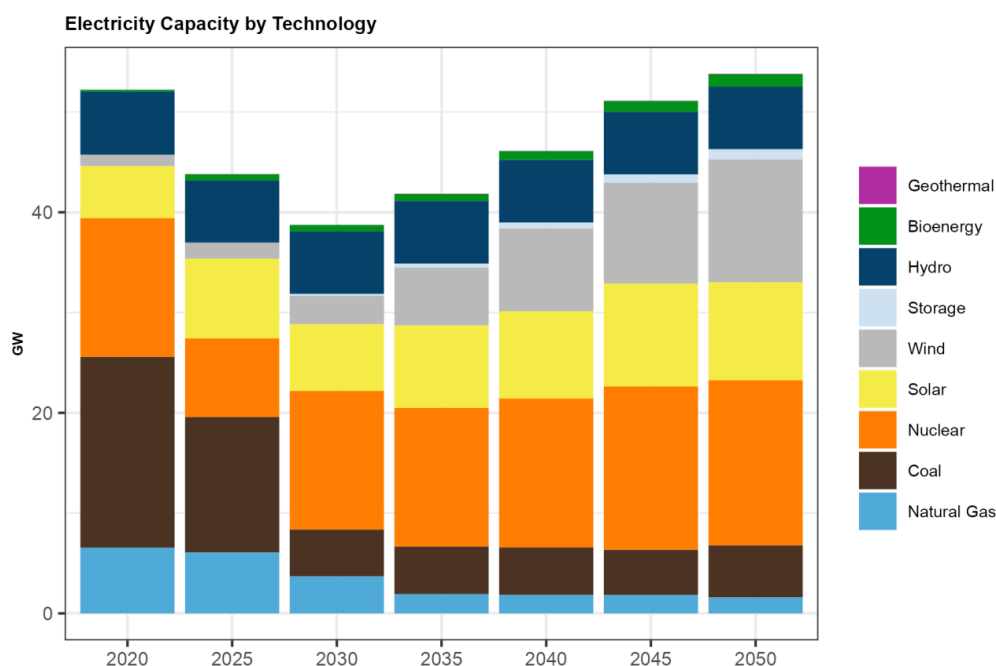
Figures 4.11 and 4.12 show the dynamics and structure of electricity production and power generation facilities in Ukraine according to the WEM scenario, respectively. Considering the simulation results, nuclear and wind energy demonstrate an extraordinary increase in generation, while the structure of the installed capacities looks quite balanced.

Figure. 4.11. Electricity production according to the WEM scenario, billion kWh



Source: calculations of the Institute of Economics and Forecasting of the National Academy of Sciences of Ukraine based on the TIMES-Ukraine model

Figure. 4.12. Installed capacity of power generation facilities according to the WEM scenario, GW



Source: calculations of the Institute of Economics and Forecasting of the National Academy of Sciences of Ukraine based on the TIMES-Ukraine model

The table below shows the forecast values and structure of total primary energy supply (PEP), final energy consumption (EPC), production of electric and thermal energy, generation capacity of the UES, as well as the share of RES under the WEM scenario.

Table 4.7. The main results of modeling the development of RES in Ukraine according to the WEM scenario

	2015	2020	2025	2030	2035	2040	2045	2050
Total supply of primary energy (TPES)								
Total supply of primary energy, Mtoe	90	82.7	60.8	74.8	80.0	88.2	95.3	99.9
Coal, %	31	26.7	25.7	17.7	16.1	15.1	14.2	14.2
Gas, %	29	30.5	29.3	27.6	29.3	28.3	27.1	26.2
Oil, %	12	13.0	13.1	12.5	12.9	12.9	13.2	13.4
Atomic energy, %	26	24.1	22.6	33.3	31.2	32.3	33.5	33.3
Hydropower, %	1	0.6	1.1	1.0	1.0	0.9	0.8	0.8
Wind energy, %	0.1	0.3	0.7	0.9	1.8	2.4	2.7	3.2
Solar energy, %	0.0	0.6	1.2	0.9	1.0	1.0	1.1	1.1
Biofuel and waste, %	2	4.4	6.6	6.6	6.4	7.0	7.5	8.0
The share of renewable energy sources in TPES, %	3.0	5.9	9.5	9.4	10.2	11.3	12.2	13.1
Final energy consumption (FEC)								
Total final energy consumption, Mtoe	48.2	43.8	34.0	40.8	44.8	49.9	53.8	56
Coal, %	8.4	4.1	6.1	4.1	2.7	3.1	2.8	1.4
Gas, %	32	29.7	26.9	28.0	27.4	26.5	25.1	24.5
Oil, %	20	21.3	20	20	20.1	19.9	20.3	21.1
Thermal energy, %	17	17.7	18.5	17.6	17.9	17.3	17.2	17.4
Electricity, %	21	21.9	22.3	23.6	24.9	25.8	26.5	27.3
RES (direct consumption), %	3	5.4	6.2	6.6	7.0	7.5	7.8	8.2
The share of RES in the gross FEC, %	6.2	8.6	13.2	13.6	15.6	17.3	18.8	20.3
Production of electricity								
Electricity production, TWh	157	148.8	117.0	146.6	163.8	189.5	211.5	227.9
Coal, %	33	27.8	24.5	11.4	11.6	10.2	8.7	9.8
Gas, %	5	8.6	8.8	5.2	4.8	4.0	3.6	2.9
Atomic energy, %	56	51.3	45	65	58.5	58.4	59.0	57.4
Biofuel and waste, %	0.1	0.6	2.1	1.7	1.9	2.0	2.2	2.4
Wind energy, %	1	2.2	3.9	5.4	10.2	13.0	14.2	16
Solar energy, %	0.1	4.0	7.3	5.0	5.6	5.2	5.6	5.1
Hydropower, %	5	4.0	6.4	6.1	5.4	5.3	4.9	4.5
Share of RES, %	6.0	10.8	19.2	17.8	22.8	25.2	26.6	28.1
The installed capacity of the UES								
Installed capacities of the UES, GW	53.4	52.2	43.8	38.8	41.9	46.1	51.1	53.8
Coal, %	48.6	36.5	30.9	12.1	11.3	10.3	8.8	9.7
Gas, %	12.7	12.5	13.9	9.5	4.6	4.0	3.6	3.0
Atomic energy, %	25.9	26.5	17.9	35.7	33.0	32.2	31.9	30.6
Biofuel and waste, %	0.2	0.4	1.4	1.7	1.7	1.9	2.1	2.3
Wind energy, %	0.8	2.1	3.6	7.2	13.8	17.9	19.7	22.8
Solar energy, %	0.8	9.9	18.2	17.2	19.6	18.9	20.2	18.2
Hydropower, %	11.0	12.1	14.2	16.1	14.9	13.5	12.2	11.6
Share of RES, %	12.8	24.5	37.4	42.2	50.1	52.2	54.1	54.9
Production of heat energy (heat supply stations)								
Heat energy production (stations heat supply), Mtoe	9.5	9.3	7.2	8.4	9.4	9.9	10.6	11.3
Coal, %	15.8	13.8	12.1	14.7	11.3	11.0	10.4	10.0
Gas, %	61.5	61.9	63.2	58.6	67.3	64.7	62.8	60.4
Biofuel and waste, %	7.4	9.5	15.8	17.8	12.5	14.7	16.8	19.0
Waste heat, %	7.0	9.1	5.1	5.7	5.9	5.5	5.4	5.6
Share of RES, %	7.4	9.5	15.8	17.7	12.5	14.7	16.8	19.0

Source: State Statistics Service, State University "Institute of Economics and Forecasting of the National Academy of Sciences of Ukraine"

4.3. Dimension Energy efficiency

i. Current primary and final energy consumption in the economy and per sector (including industry, residential, service and transport)

The final energy consumption as of 2020 was 47.8 Mtoe (without taking into account the temporarily occupied territory of the Autonomous Republic of Crimea and the city of Sevastopol and part of the temporarily occupied territories in the Donetsk and Luhansk regions). A significant decrease in final energy consumption occurred in 2014 (by 12.4%) due to the influence of a number of factors: the occupation of the Autonomous Republic of Crimea and a significant area of industrial zones in the Donetsk and Luhansk regions, economic recession, energy supply restrictions, and rising energy prices. In 2016 and 2018, an increase in final energy consumption was observed due to the influence of structural factors: economic revival and the normalization of energy supply to consumers. This growth of final energy consumption, accordingly, influenced the growth of primary energy consumption in these years. As of 2020, the primary energy consumption amounted to 82.7 Mtoe.

Figure. 4.13. Dynamics of changes in primary and final energy consumption, 2013-2020

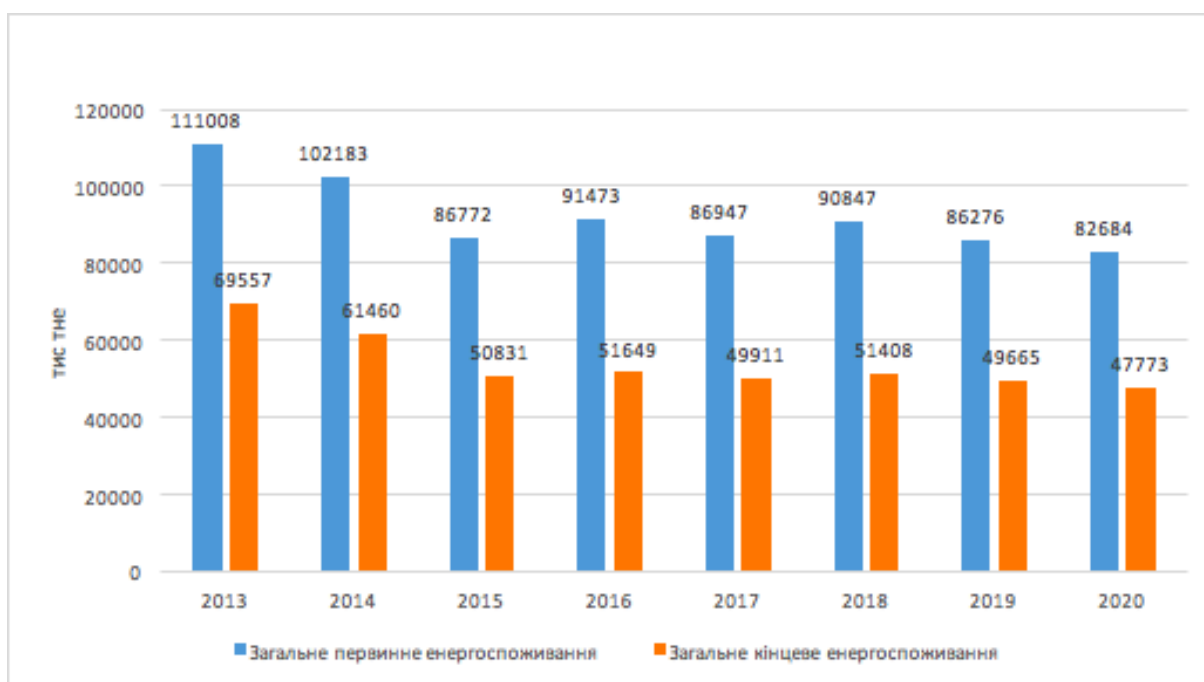
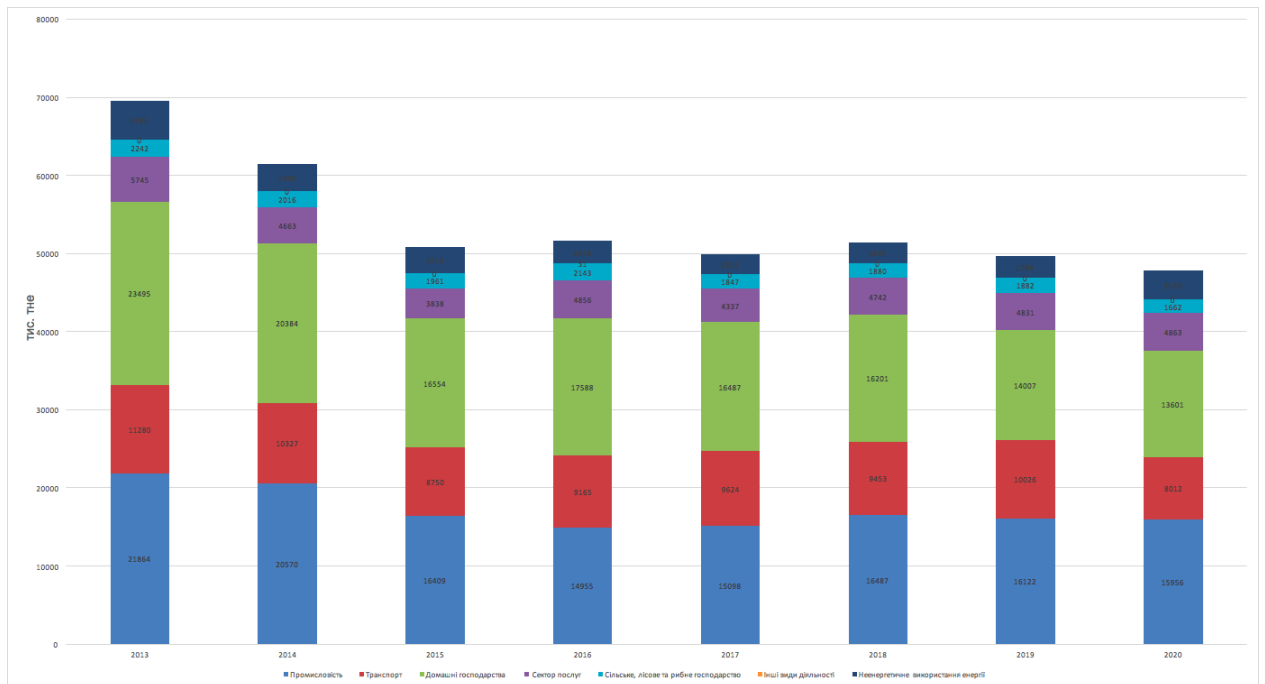


Figure. 4.14. Dynamics of changes in final energy consumption by sector, 2013-2020



**For 2014-2021, excluding the temporarily occupied territory of the Autonomous Republic of Crimea and the city of Sevastopol and part of the temporarily occupied territories in the Donetsk and Luhansk regions.*

Source: State Statistics Service

In 2020, industry accounted for the largest share of final energy consumption (33.4%). The second largest energy consumption was the residential sector, which accounted for 28.5%. The transport sector consumed 16.8% of energy, the service sector - 10.2%, non-energy consumption - 7.7%, agriculture, forestry and fishing - 3.5%.

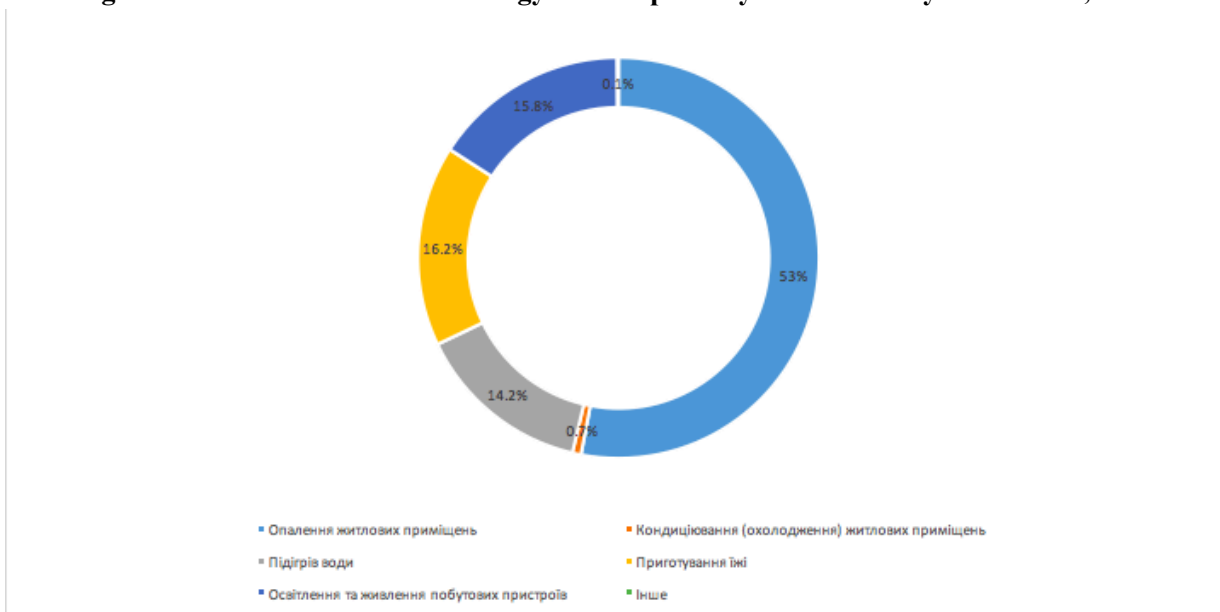
Figure. 4.15. Final energy consumption by sector, 2020*



Source: State Statistics Service

In the structure of final energy consumption by households, the largest share is occupied by heat supply (53%). Cooking uses 16.2% of energy, lighting and powering household appliances - 15.8%, heating water - 14.2%

Figure. 4.16. Structure of final energy consumption by households by destination, 2020



Source: State Statistics Service

There are no state statistics data on final energy consumption for 2021-2022 as of the end of 2023. According to the Government's statements, as a result of the full-scale invasion of the Russian Federation into Ukraine, energy consumption decreased by 30-35% compared to 2021.

During the first year of hostilities, the housing sector (38% of the total amount of damage), transport (26%), energy (8%), trade and industry (8%), and agriculture (6%) were the most affected ⁴⁰². According to the World Bank, up to 1.4 million housing units (apartments) were destroyed or damaged; 135,000 individual residential buildings; up to 39,040 residential units (rooms) in dormitories. Donetsk, Kharkiv, Luhansk, Kyiv, and Mykolaiv regions suffered the most damage. It is estimated that more than one-third (499,056 dwelling units) of all damaged housing units were destroyed.

Public buildings also suffered significant destruction. As of February 24, 2023, at least 2,772 educational institutions were partially damaged (454 were destroyed), which together represents approximately 10% of all educational institutions (of all levels) in Ukraine. The Russian Federation continues the purposeful destruction of educational institutions in 2024. 15.9% of public healthcare facilities (1,574 facilities) were damaged or destroyed.

Disruptions in the industrial sector have a significant impact on the change in final energy consumption. According to data from the Kyiv School of Economics, as of September 1, 2023, the losses of industry and enterprises number at least 426 large and medium-sized private enterprises and state-owned companies that were damaged or destroyed as a result of hostilities ⁴⁰³. He suffered the most

⁴⁰²

<https://documents1.worldbank.org/curated/en/099062823034041908/pdf/P18017401fe8430010af21016afb4ebc8c4.pdf>

⁴⁰³

<https://kse.ua/ua/about-the-school/news/zagalna-suma-pryamih-zbitkiv-zavdana-infrastrukturi-ukrayini-cherez-viynu-syagaye-151-2-mlrd-otsinka-stanom-na-1-veresnya-2023-roku/>

metallurgy sector: destroyed PrJSC "MK "Azovstal" and PrJSC "MMK named after Ilyich" in Mariupol, the second and third largest metallurgical plants in Ukraine.

Along with the destruction of housing and infrastructure, Ukraine also experienced a significant population decline. According to the Institute of Demography, as of January 1, 2023, the population of Ukraine ranged from 28 million to 34 million people ⁴⁰⁴, while as of February 1, 2022, this indicator was 41.1 million people (excluding the temporarily occupied territory of the Autonomous Republic of Crimea and the city of Sevastopol) ⁴⁰⁵. The UN records 6.2 million officially registered refugees from Ukraine as of October 2023. ⁴⁰⁶

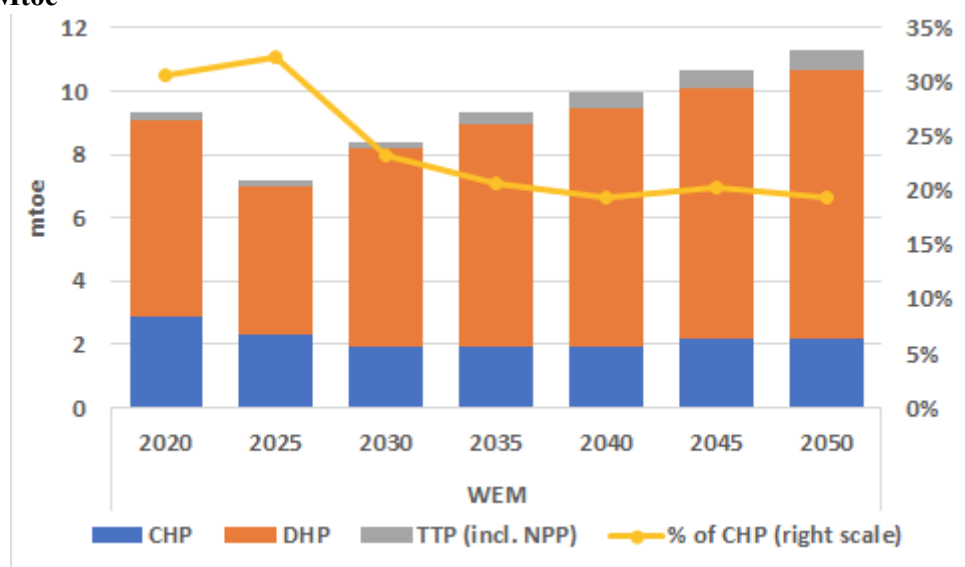
Large-scale destruction, structural changes in the economy and population decline will have a decisive impact on the change in final energy consumption. At the same time, it is expected that the restoration of destroyed buildings, infrastructure, and industry will take place according to the "build back better" principle, which will result in a reduction in energy consumption.

ii. Current potential for the application of high-efficiency cogeneration and efficient district heating and cooling

As of the end of 2023, the assessment of the potential for the use of highly efficient cogeneration and efficient centralized heating and cooling in accordance with the requirements of Directive 2012/27/EU has not been carried out.

The results of the WEM scenario simulation using the TIMES-Ukraine model show that both absolute and relative cogeneration of electricity and heat at CHP will decrease throughout the model period (*figure below*), while production of heat by boilers (*DHP*), especially factory boilers (automakers) will grow. In addition, heat production at NPPs may increase, taking into account the projected development of nuclear energy, which is also cogeneration, in fact, but with a small share of heat.

Figure. 4.17. Thermal energy production by types of generating facilities in the WEM scenario, Mtoe



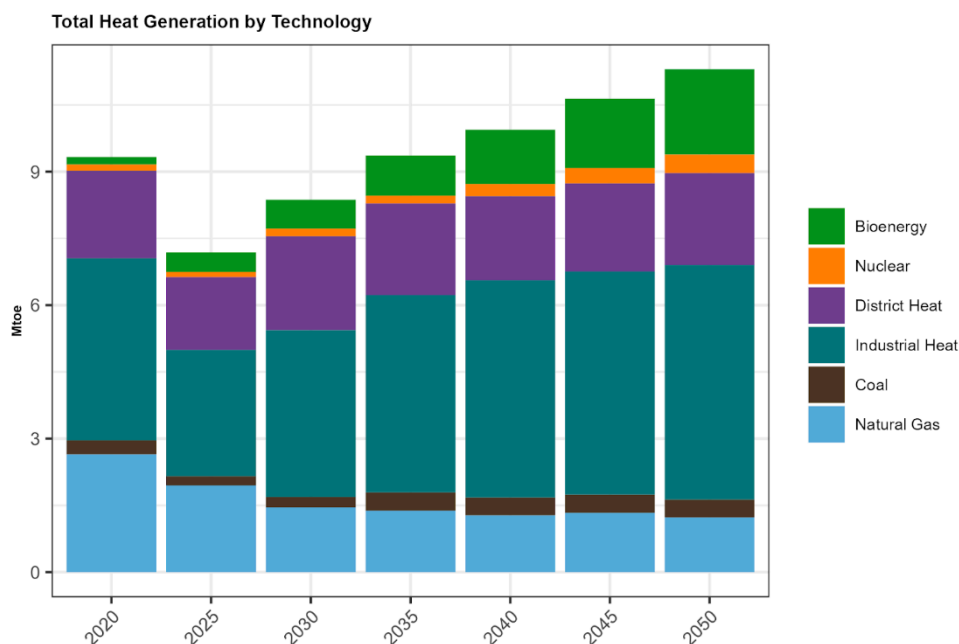
Source: calculations of the Institute of Economics and Forecasting of the National Academy of Sciences of Ukraine based on the TIMES-Ukraine model

⁴⁰⁴ <https://voxukraine.org/fejk-za-chas-vijny-naselennya-ukrayiny-skorotylosya-do-20-miljoniv>

⁴⁰⁵ <https://www.ukrstat.gov.ua/>

⁴⁰⁶ <https://data.unhcr.org/en/situations/ukraine>

Figure. 4.18. Production of thermal energy by fuel types with allocation of centralized heat supply in the WEM scenario, Mtoe



Source: calculations of the Institute of Economics and Forecasting of the National Academy of Sciences of Ukraine based on the TIMES-Ukraine model

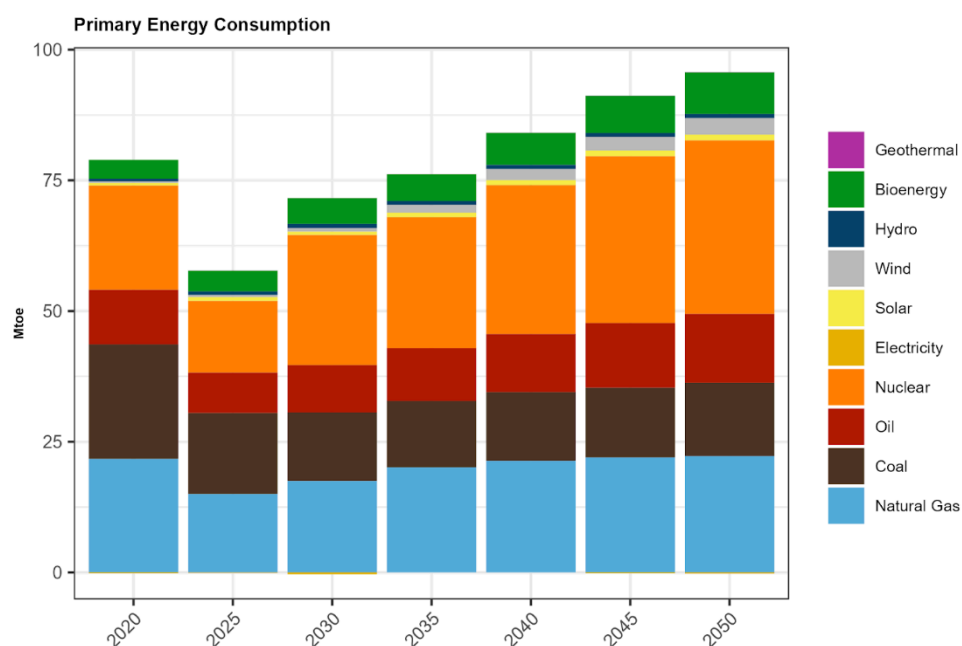
iii. Projections considering existing energy efficiency policies, measures and programmes as described in point 1.2.(ii) for primary and final energy consumption for each sector at least until 2040 (including for the year 2030)

The results of simulations based on the WEM scenario confirm that the post-war recovery of the economy and the reintegration of the temporarily occupied territories of Ukraine will contribute to a significant increase in the demand for energy resources - especially in the first 5-10 years.

At the same time, the current measures and policies in the field of energy efficiency and renewable energy will not ensure the stabilization of primary energy consumption (PEC) after the post-war recovery and under the conditions of the WEM scenario, the level of PEC in 2020 may be reached by 2040 . and only after 2045 can the level of the upper limit (91.47 Mtoe) approved for Ukraine by the decision of the Council of Ministers of the Energy Community, in particular regarding national contributions to energy efficiency ⁴⁰⁷ . At the same time, the growth of PEC will be ensured primarily due to a significant increase in capacity and electricity production at nuclear power plants and the use of RES (figure below).

⁴⁰⁷ [Decision 2022/02/MC-EnC on amending Decision 2021/14/MC-EnC and incorporating Directives \(EU\) 2018/2001 and 2013/2002, Regulations \(EU\) 2018/1999, 2020/1044, and 2020/1208 in the Energy Community acquis](#)

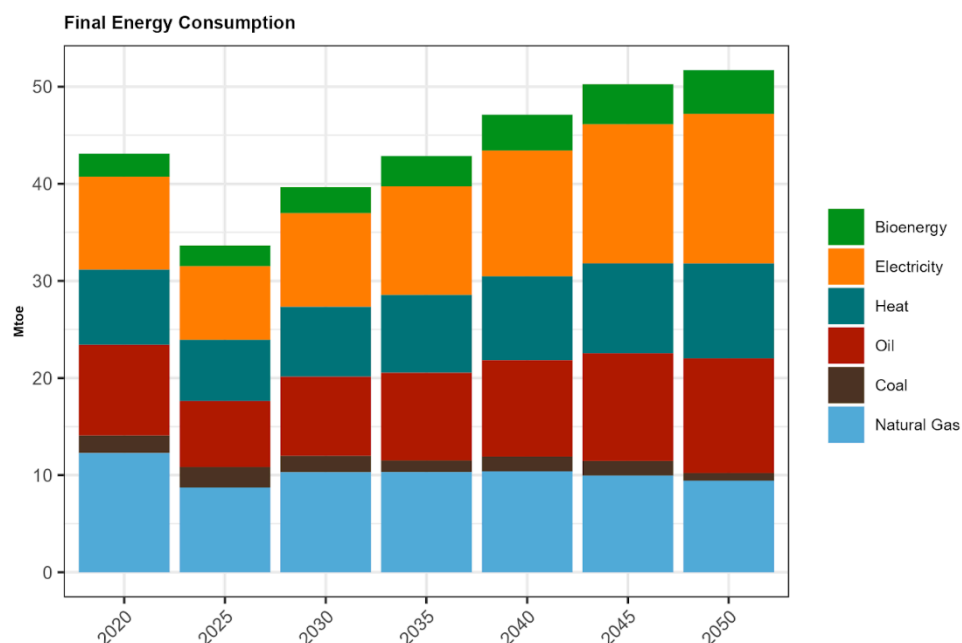
Figure. 4.19. Primary energy consumption in the WEM scenario, Mtoe



Source: calculations of the Institute of Economics and Forecasting of the National Academy of Sciences of Ukraine based on the TIMES-Ukraine model

The dynamics of final energy consumption (FES) is similar to the dynamics of PEC, however, in the WEM scenario, the growth rate of FEC is slightly higher than the growth rate of PEC due to the increase in electricity consumption, which indicates an increase in the efficiency of the energy transformation sector.

Figure. 4.20. Final consumption by types of energy in the WEM scenario, Mtoe

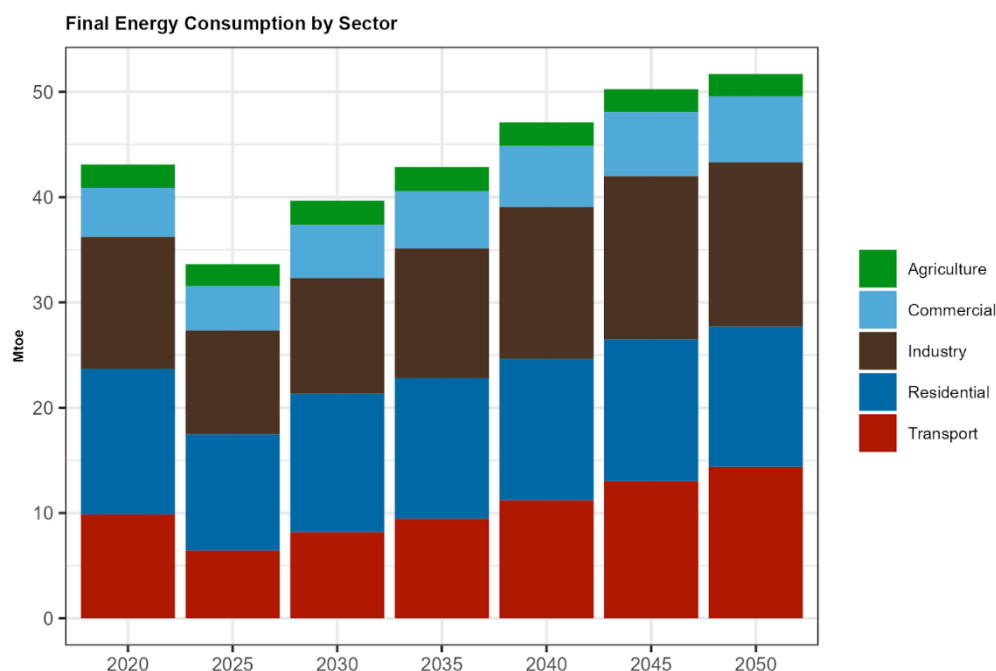


Source: calculations of the Institute of Economics and Forecasting of the National Academy of Sciences of Ukraine based on the TIMES-Ukraine model

After a radical drop in energy consumption in 2022 as a result of the Russian Federation's full-scale invasion of Ukraine, all FEC sectors will see an increase in energy demand until 2030, especially in

industry and transport, driven by economic recovery and the reintegration of temporarily occupied territories, which will continue beyond 2030

Figure. 4.21. Final energy consumption by sector in the WEM scenario, Mtoe



Source: calculations of the Institute of Economics and Forecasting of the National Academy of Sciences of Ukraine based on the TIMES-Ukraine model

The results of modeling of final energy consumption by sectors and types of fuel in Ukraine are shown in the table below.

Table 4.8. Final energy consumption by sectors and types of fuel, Mtoe

	2015	2020	2025	2030	2035	2040	2045	2050
Final energy consumption in the service sector								
FEC in the service sector, Mtoe	3.8	4.7	4.2	5.1	5.4	5.8	6.1	6.3
Coal, %	3,4	4.4	3.2	3.2	2.4	1.5	0.7	0.1
Gas, %	9	15.2	11.8	15.7	14.6	12.7	8,9	5,6
Oil, %	5.4	2.4	0.04	0.01	0.01	0.3	0.1	0.0
Thermal energy, %	38.4	44.5	51.1	42.6	43.7	43.1	46.0	48.8
Electricity, %	39	27.2	28.7	28.8	28.8	28.8	28.8	28.8
RES (direct consumption), %	3.7	6.3	5.2	9.7	10.5	13.7	15.5	16.7
Final energy consumption in industry								
FEC in industry, Mtoe	15.7	19.7	14.2	17.2	20.6	24.6	27.0	28.6
Coal, %	23	15	18.3	12.6	8.5	8.4	6.6	3.8
Gas, %	25.2	42.3	38.7	41.3	43.0	42.3	42.9	44.2
Oil, %	2.8	2,2	2,3	2.5	2.6	2.6	2.7	2.7
Thermal energy, %	16.6	18.5	17.5	18.0	18.1	17.4	17.2	17.2
Electricity, %	27.4	21.7	22.0	23.3	24.1	24.8	25.5	26.2

RES (direct consumption), %	0.5	0.5	1.3	2,3	3.7	4.6	5.2	6.0
Final energy consumption in the residential sector								
FEC in the residential sector, Mtoe	16.6	13.8	11.1	13.2	13.4	13.5	13.5	13.3
Coal, %	2	1	0.1	1	1	1	1	1.1
Gas, %	55.5	48.2	50.4	50.9	50.7	50.6	50.5	50.5
Oil, %	0.1	0	0	0	0	0	0	0
Thermal energy, %	17.5	13.9	12.6	12.5	12.2	11.8	11.5	11.3
Electricity, %	18.5	22.8	21.9	22.6	23.7	24.5	25.2	25.8
RES (direct consumption), %	6.6	14.1	15.2	13.0	12.4	12.1	11.8	11.4
Final energy consumption in the transport sector								
FEC in the transport sector, Mtoe	10	9.9	6.4	8.2	9.5	11.2	13.0	14.4
Coal, %	0.05	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Gas, %	14.7	16.5	9.4	10.0	11.0	13.9	13.8	14.0
Oil, %	75.7	75.8	81.4	78.2	76.1	71.5	70.5	69.4
Electricity, %	8,9	7.1	8.3	10.8	11.8	13.5	14.6	15.6
RES (direct consumption), %	0	0	0.1	0.3	0.3	0.3	0.4	0.4
Final energy consumption in agriculture								
FEC in agriculture, Mtoe	2,3	2,2	2.1	2,3	2,3	2,3	2,2	2.1
Coal, %	0.6	0.6	0.6	0.6	0.6	0.5	0.5	0.5
Gas, %	8.5	8.7	8.4	8.2	8.0	7,8	7.6	7.4
Oil, %	60.5	59.7	60.0	58.2	56.7	55.1	53.1	50.7
Thermal energy, %	14.2	14.5	14.5	14.4	14.4	14.4	14.4	14.3
Electricity, %	15	15.3	14.6	14.9	15.0	15.1	15.3	15.4
RES (direct consumption), %	1,2	1,2	1.8	3.8	5.3	7.0	9.1	11.7

Source: State Statistics Service, State University "Institute of Economics and Forecasting of the National Academy of Sciences of Ukraine"

v. *Cost-optimal levels of minimum energy performance requirements resulting from national calculations, in accordance with Article 5 of Directive 2010/31/EU, as adapted and adopted by Ministerial Council Decision 2010/02/MC-EnC and by the Ministerial Council Decision 2021/14/MC-EnC*

The minimum requirements for the energy efficiency of buildings are established on the basis of data calculated for reference buildings, taking into account the requirements for thermal technical characteristics of enclosing structures and energy efficiency of engineering systems (including equipment) of buildings, in accordance with an economically feasible level, taking into account the cost of discounted general costs for the implementation of measures on increasing the level of energy efficiency relative to the estimated service life of each reference building, and are differentiated depending on the functional purpose, the height of the buildings and the type of construction work (new construction, reconstruction, capital repair).

- In the case of new construction, reconstruction, which leads to a change in the functional purpose of the building, the minimum requirement for the energy efficiency of the building is class "C".
- In the case of reconstruction, capital repair of buildings as a whole or their separate parts, the minimum requirement is the fulfillment of the following conditions:

$$EP_{use} \leq 1.2 \times EP_p, \quad (1)$$

where: **ER_{use}** - the total indicator of specific energy consumption during heating and cooling, $\text{kW} \times \text{h}/\text{m}^{-2}$, $(\text{kW} \times \text{h}/\text{m}^{-3})$, which is calculated according to [the Methodology of determination energy efficiency of buildings](#);

ER_r - the limit value of specific energy consumption during heating and cooling of residential and public buildings, $\text{kW} \times \text{h}/\text{m}^{-2}$, $(\text{kW} \times \text{h}/\text{m}^{-3})$, which is given in Table 5 below.

- In the case of reconstruction, major repair of parts of the building (individual enclosing structures as a whole) specified in the project documentation, the minimum requirement is the fulfillment of the following conditions:

where: **R_{Σ np}** - reduced heat transfer resistance of the enclosing structure, $\text{m}^{-2} \times \text{K}/\text{W}$, which is determined according to DBN V.2.6-31:2016 "Thermal insulation of buildings" (hereinafter - DBN B.2.6-31);

R_{q min} - the minimum permissible value of heat transfer resistance, $\text{m}^{-2} \times \text{K}/\text{W}$, which is determined according to DBN B.2.6-31.

Table 4.9. Limit values of specific energy consumption during heating and cooling of residential and public buildings

No. z/p	Type of building (reference buildings)	Limit value of specific energy consumption of buildings during heating and cooling, ERr, kWh/m ⁻² [kWh/m ⁻³], for the temperature zone of Ukraine	
		I	II
1	Residential buildings (floor):		
	from 1 to 3	120	110
	from 4 to 9	85	75
	from 10 a.m. to 4 p.m	75	70
	17 and over	70	65
2	Public buildings (floor):		
	from 1 to 3	[38Abci + 15]	[34Abci + 13]
	from 4 to 9	[30]	[25]
	10 or more	[25]	[20]
3	Separate types of public buildings:		
3.1	Hotel buildings	57Abci + 60	50Abci + 55
3.2	Buildings of educational institutions	[55Abci + 24]	[52Abci + 23]
3.3	Buildings of preschool education institutions	[32]	[28]
3.4	Buildings of healthcare institutions	[30]	[26]
3.5	Commercial buildings	[33Abci + 17]	[26Abci + 15]

Note: Abci - the coefficient of compactness of the building, m⁻¹, is found in accordance with DBN V.2.6-31:2016 "Thermal insulation of buildings".

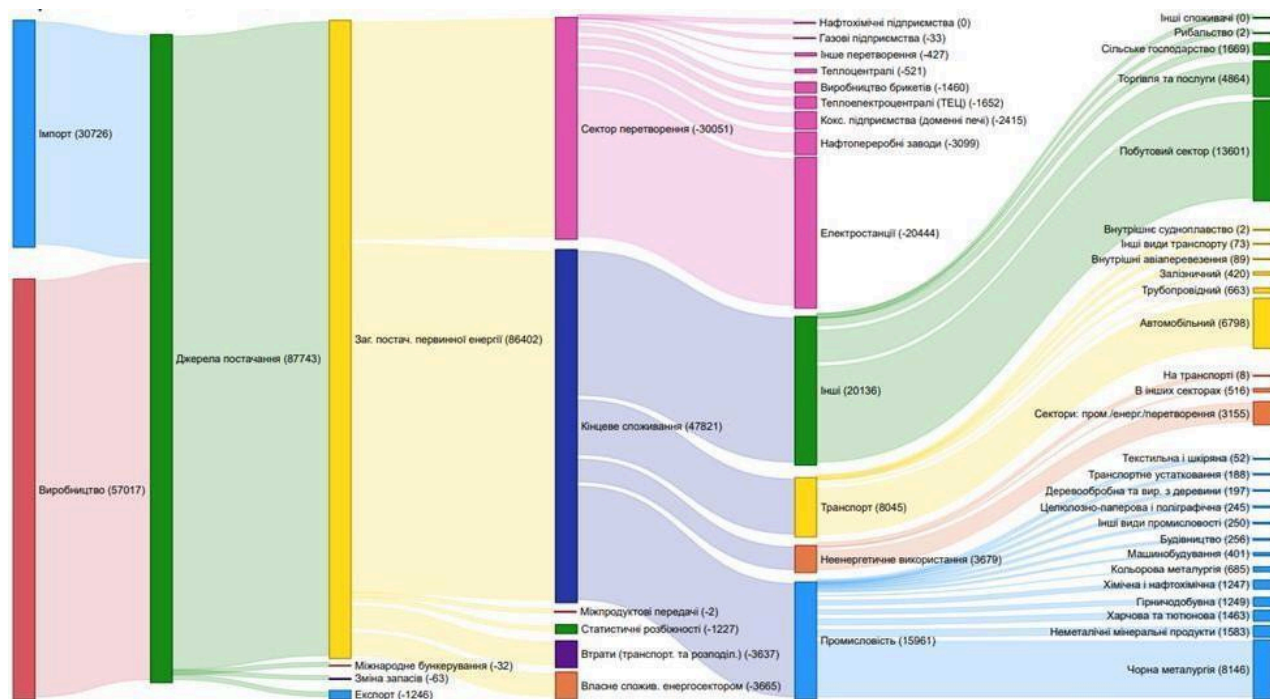
4.4. Dimension Energy security

i. Current energy mix, domestic energy resources, import dependency, including relevant risks

In recent years, the total supply of primary energy in Ukraine has been at the level of 86-93 Mtoe, which is almost a third less than in 2010. The gradual decline corresponds, on the one hand, to the dynamics of economic development/decline, and on the other hand, to an increase in the efficiency of energy conversion and consumption.

At the same time, import indicators were quite stable. As of 2020, imports amounted to 30.7 Mtoe, or about 35% of the total sources of primary energy supply. The share of own production in TPES was 65% in 2020, and did not exceed 70% in the previous 5 years.

Fig. 4.22. Energy flows, thousand toe, 2020

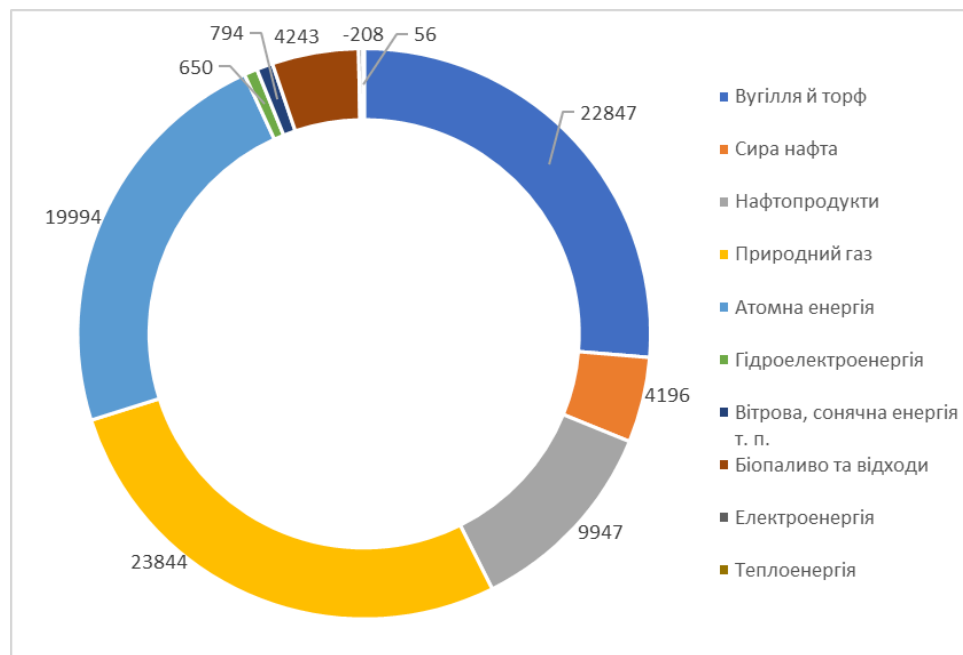


Source: State Statistics Service⁴⁰⁸

According to the Energy Balance for 2020, the current energy balance of Ukraine includes four main energy sources covering almost 90% of the total primary energy supply (TPES): coal (26.5%), natural gas (27.6%), nuclear energy (23.2%) and oil products (11.5%). The share of renewable energy sources, including hydropower, is 6.6%.

⁴⁰⁸ https://www.ukrstat.gov.ua/operativ/operativ2020/energ/drpeb/graf_u.zip

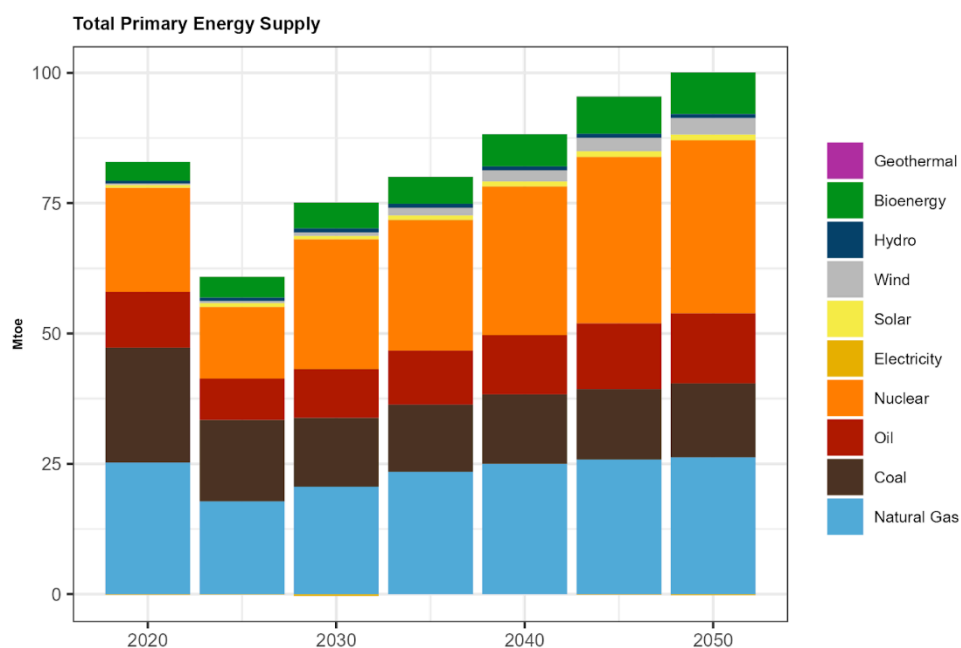
Fig. 4.23. Energy balance of Ukraine for 2020



Source: State Statistics Service⁴⁰⁹

The figure below shows the results of the simulation of the dynamics of Ukraine's TPES under the WEM scenario using the TIMES-Ukraine model.

Fig. 4.24. Total primary energy supply in 2020-2050, Mtoe



Source: calculations of the Institute of Economics and Forecasting of the National Academy of Sciences of Ukraine based on the TIMES-Ukraine model

⁴⁰⁹ https://www.ukrstat.gov.ua/operativ/operativ2021/energ/drpeb/EBTS_2021_ua.xls

Despite the decline of net imports in absolute terms in the 1990s and 2000s, which has stabilized in the last 5 years, the dynamics of providing the economy with its own resources looks different in terms of individual energy resources.

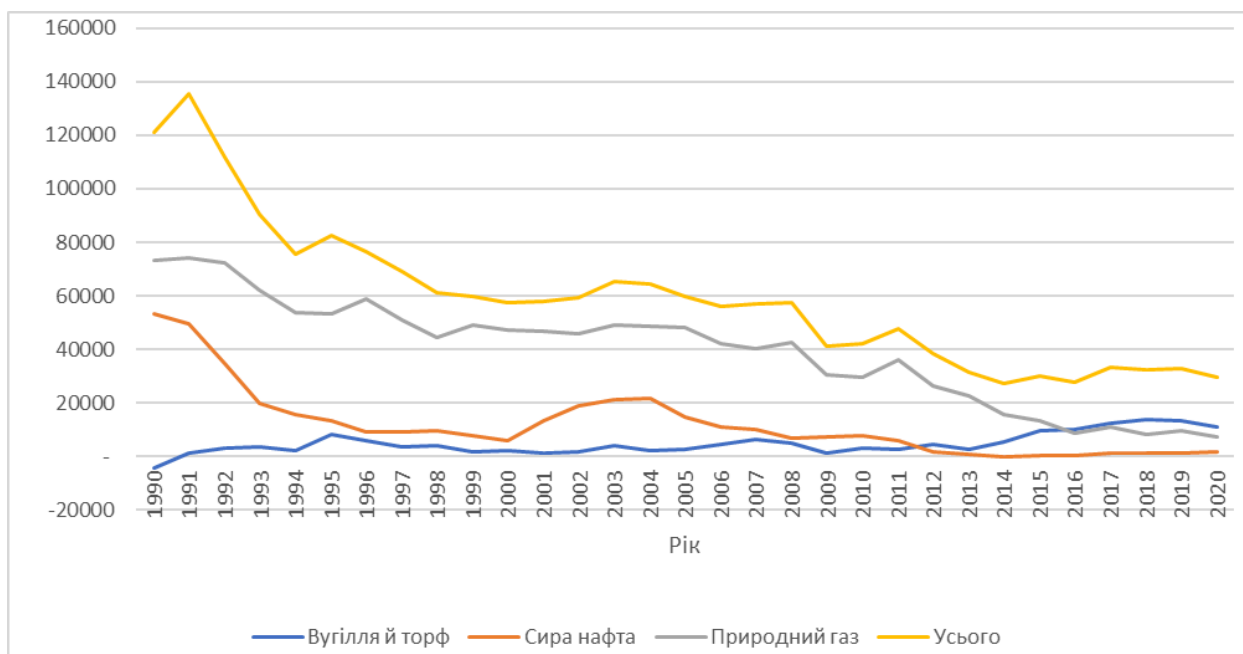
Thus, there was a significant decline in the supply of coal and peat with own resources - from 98.5% in 2013 to 55.8% in 2020. This is largely due to the loss of control over the mining enterprises in the territories occupied by the Russian Federation, as well as the further decline in the production indicators of the state-owned mines. According to the State Customs Service, in 2022 Ukraine reduced the import of hard coal and anthracite by 4.2 times (by 14,932.904 thousand tons) compared to 2021 - to 4,630.144 thousand tons ⁴¹⁰.

A similar trend was observed in the provision of crude oil, which amounted to 59% in 2020. But even this relatively satisfactory indicator only takes into account the demand of Ukrainian refineries, and if we take into account the market of motor fuels, according to the Energy Balance (Product) for 2017 (the latest complete data on production), imports accounted for almost 64% of the domestic supply of gasoline, 87 % for gas oil/diesel, 75% for liquefied petroleum gas. According to the State Customs Service, Ukraine imported 7,300.073 thousand tons of oil products in 2022, which is 17% less than in 2021 (8,790.515 thousand tons) ⁴¹¹.

On the other hand, the situation with regard to natural gas has significantly improved. Provision of own resources increased from 40.6% in 2013 to 66.5% in 2020. The main factors were the stabilization of production, despite the loss of resources in the occupied territories (in particular, the Black Sea offshore) and the low level of investment in new drilling, as well as a significant reduction in consumption in both the industrial and household segments. According to industry data, total gas consumption in 2022 decreased by 31% to 19.8 bcm, while production amounted to 18.5 bcm.

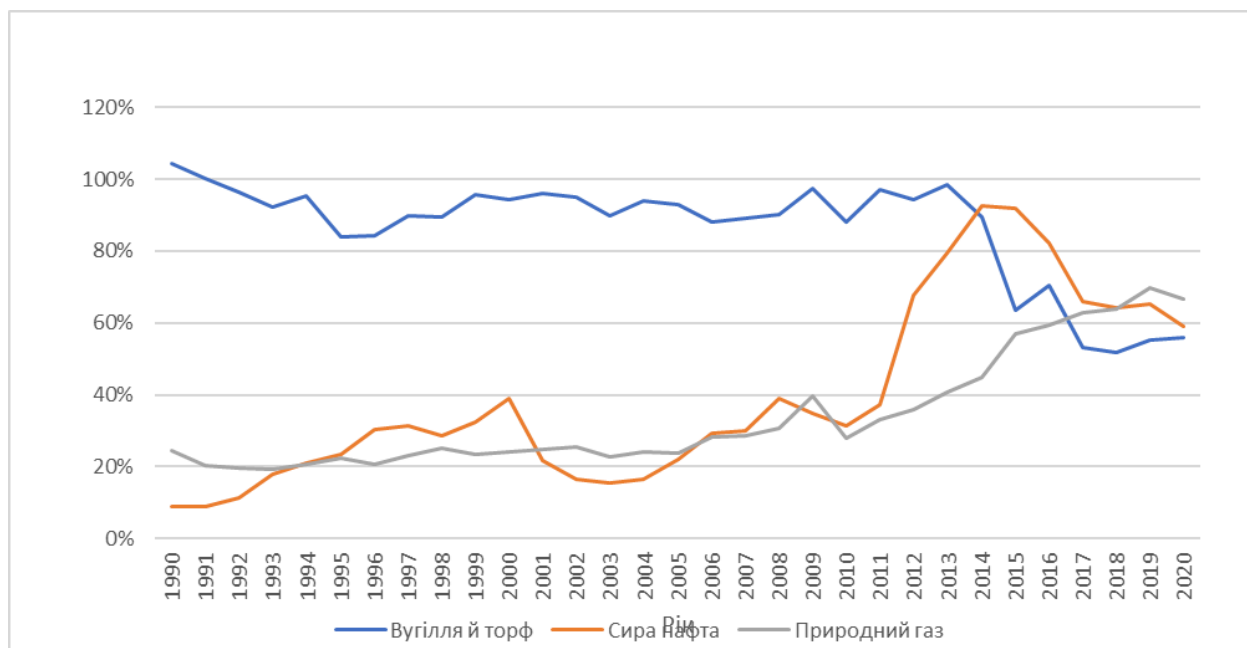
In terms of nuclear fuel, JSC NAEK Energoatom decided to stop importing Russian products in favor of Westinghouse, and from 2025 it plans to supply itself with products of its own production by 50%.

Fig. 4.25. Net energy imports, thousand toe



Source: State Statistics Service⁴¹²

Fig. 4.26. Provision of Ukraine's economy with its own resources, %



Source: State Statistics Service⁴¹³

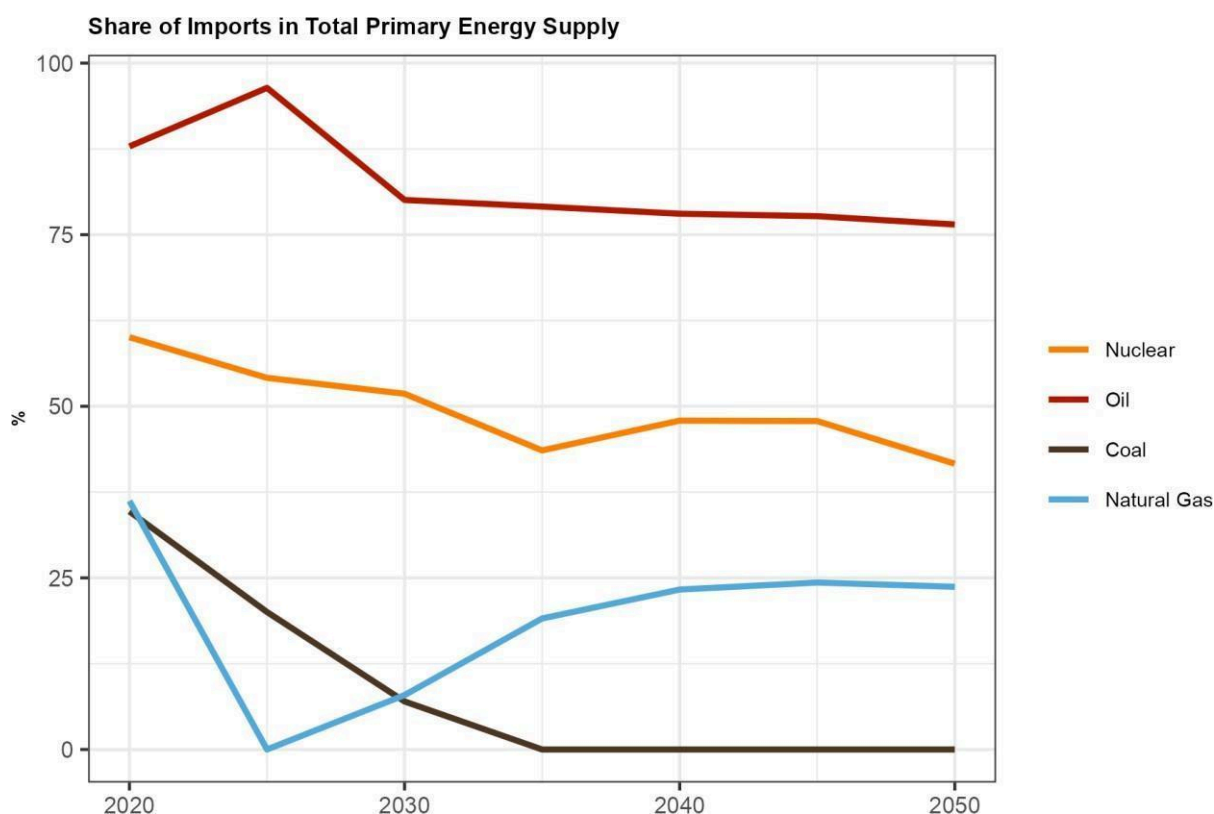
⁴¹² https://www.ukrstat.gov.ua/operativ/operativ2021/energ/drpeb/EBTS_2021_ua.xls

⁴¹³ https://www.ukrstat.gov.ua/operativ/operativ2021/energ/drpeb/EBTS_2021_ua.xls

ii. *Projections of development with existing policies and measures at least until 2040 (including for the year 2030)*

For the implementation of WEM scenario measures, dependence on the import of oil and petroleum products, as well as uranium ore (especially nuclear fuel), remains a challenge. Due to the drop in demand for natural gas during the war years, the increase in its production, as well as due to energy efficiency and the development of RES, dependence on natural gas imports, after complete avoidance by 2025, may increase to 20-24% in 2035-2050 (Fig. 4.27).

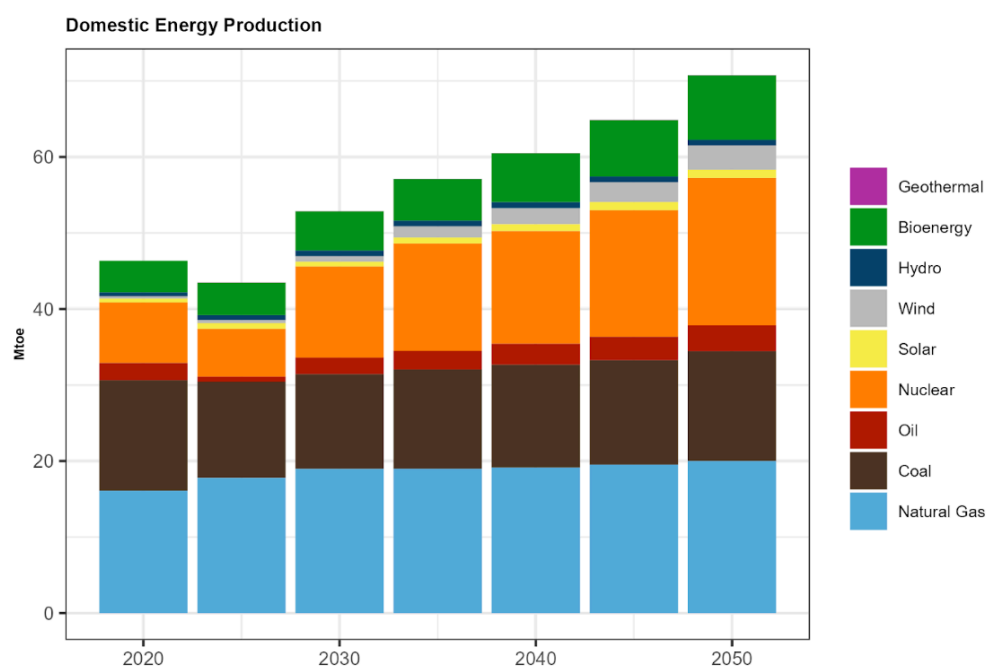
Fig. 4.27. Forecast of providing Ukraine's economy with its own energy resources according to the WEM scenario, %



Source: calculations of the Institute of Economics and Forecasting of the National Academy of Sciences of Ukraine based on the TIMES-Ukraine model

According to the WEM scenario, an increase in the production of energy resources is predicted, primarily uranium ore production, as well as renewable energy resources.

Figure. 4.28. Forecast of production and supply of energy resources, Mtoe



Source: calculations of the Institute of Economics and Forecasting of the National Academy of Sciences of Ukraine based on the TIMES-Ukraine model

4.5. Dimension Internal energy market

4.5.1. Electricity interconnectivity

i. Current interconnection level and main interconnectors

Ukraine has direct electricity connections with the ENTSO-E countries and Moldova. Until February 24, 2022, due to the technical features of Ukraine's energy system, there were two separate trading zones: Island of Burshtyn TPP (synchronized with ENTSO-E) and United Energy System (UES) of Ukraine (synchronized with the Russian Federation and the Republic of Belarus). In order to test the stability of the energy system in preparation for integration with the energy systems of the ENTSO-E countries, since February 24, the UES of Ukraine was disconnected from the systems of the Russian Federation and the Republic of Belarus, and the internal systems (trade zones) were synchronized. From March 16, 2022, the unified trade zone of the UES of Ukraine functions simultaneously with electricity systems of continental Europe ENTSO-E.

The task of integrating the UES of Ukraine into ENTSO-E has been completed, at the same time, it is necessary to additionally implement technical measures to eliminate the insufficient damping of low-frequency interregional power fluctuations involving the energy systems of Ukraine and Moldova.⁴¹⁴

⁴¹⁴ According to the conclusions of the report "Dynamic calculations for a synchronous interconnection of the grids of Continental Europe and Ukraine/Moldova using the present network" of the ENTSO-E Consortium

NEC Ukrenergo can transmit electricity through interconnectors to Hungary (up to 650 MW), Slovakia (up to 400 MW), Romania (up to 400 MW), Poland (up to 1,210 MW), as well as to Moldova (the amount of electricity flow from UES of Ukraine to the power system of Moldova can be up to 600 MW, but during peak hours it is limited to 260 MW, and during repair work on adjacent 330 kV substations - to zero). According to the Transmission System Development Plan for 2024-2033, the goal of NEC Ukrenergo is to implement measures aimed at improving the dynamic stability of the energy system to ensure the technical possibility of a gradual increase in electricity exports.⁴¹⁵

In 2023, Ukraine made the transition to uniform European rules for access to cross-border lines for electricity exporters and importers. Market participants get access to the capacity of interconnectors of Ukraine based on the results of open auctions conducted by the auction office of the transmission system operator NEC Ukrenergo⁴¹⁶ together with the TSOs of neighboring countries (Romania and Moldova). Auctions for the allocation of access to interconnectors of Ukraine with Poland, Slovakia and Hungary from 2024 take place on the pan-European auction platform Joint Allocation Office (JAO). In particular, on September 12, 2023, the NEURC adopted resolution No. 1683 "On approval of the rules for the allocation of capacity of interconnectors Ukraine - Poland, Ukraine - Slovakia, and Ukraine - Hungary."⁴¹⁷

Before the emergency synchronization of the UES of Ukraine with the ENTSO-E energy systems on March 16, 2022, the annual amount of electricity transmission was up to 7 TWh. According to the estimates of NEC Ukrenergo, the additional volume of transmission under the condition of restoration of the interconnectors Khmelnytska NPP - Rzeszów and Pivdennoukrainska NPP - Issaccea can be up to 16 TWh per year. Thus, the annual volume of electricity transmission from Ukraine to ENTSO-E countries can reach up to 30 TWh.

Table 4.10. Cross-border transmission lines of the UES of Ukraine (as of 2022)

Country	Number of power lines by voltage (kV), pcs.						
	750 kV	400 kV	330 kV	220 kV	110 kV	35 kV	6-10 kV
Poland		1*		1			
Slovakia		1				1	
Hungary	1	1		2			
Romania		1					
Moldova			7		12	1	1
Total connections with ENTSO-E countries	1	4	7	3	12	2	1

* in 2023, NEC Ukrenergo implemented a project to restore the operation of the line Khmelnytska NPP - Rzeszów and transferred it to a lower voltage (from 750 kV to 400 kV).

After synchronization with the UES of Ukraine, on June 7, 2022, ENTSO-E made a decision on the gradual expansion of the permitted capacity for electricity imports/exports. Commercial exchanges of electricity with EU countries at a minimum level began on June 30, 2022

⁴¹⁵ <https://zakon.rada.gov.ua/rada/show/v2634874-23#Text>

⁴¹⁶ <https://eap-office.ua.energy/pages/dashboard>

⁴¹⁷ <https://zakon.rada.gov.ua/rada/show/v1683874-23#Text>

(the permitted volume of export capacity was 100 MW). During July 2022 - November 2023, there was a gradual increase in the volume of permitted capacity for exports and imports of electricity. In March 2023, ENTSO-E increased the permitted technical capacity for importing electricity from EU countries to Ukraine and Moldova to 700 MW, in April – to 850 MW, in May – to 1,050 MW, and in June – to 1,200 MW.⁴¹⁹

In November 2023, the ENTSO-E Regional Group "Continental Europe" confirmed the full implementation by NEC Ukrenergo of all technical measures of the Catalog of Measures,⁴²⁰ which is an integral part of the Agreement on the conditions for the future integration of energy systems of Ukraine and Continental Europe, announced the completion of the full synchronization project of the energy systems of Ukraine and ENTSO-E and made a decision to increase the volume of permitted interconnector capacity for importing electricity to Ukraine and Moldova to 1,700 MW.⁴²¹ This decision was based on the results of studies of the safety and stability of the synchronous operation of the Ukrainian and European energy systems.

A further gradual increase in the permitted technical capacity for the imports of electricity from the EU countries to Ukraine/Moldova is expected in accordance with the decisions of ENTSO-E. As of 2024, the technical possibility to export electricity from Ukraine/Moldova to the ENTSO-E countries is 550 MW.⁴²²

Also, in March 2023, a new agreement on the provision of emergency support for the Ukrainian TSOs entered into force, which allows NEC Ukrenergo to make a request for activation, and TSOs of neighboring countries to offer emergency support in cases of failure of generating capacities or electricity transmission capacities or situations the occurrence of a sudden imbalance between the demand and supply of electricity.⁴²³

ii. Projections of interconnector expansion requirements (including for the year 2030)

The ESU determines the needs for further capacity development of interconnectors of Ukraine with ENTSO-E countries. In particular, by 2032 it is planned to increase the capacity of interconnectors to 6 GW, and by 2050 to 10 GW in order to ensure more intensive cross-border trade in electricity and services.

TSO within the framework of the basic document assessing the prospects for the development of the electricity sector - the Generation capacity adequacy assessment report⁴²⁴

⁴¹⁸

<https://www.entsoe.eu/news/2023/04/19/further-increase-in-the-trade-capacity-with-the-ukraine-moldova-power-system/>

⁴¹⁹

<https://www.entsoe.eu/news/2023/06/21/press-release-further-increase-in-the-trade-capacity-with-the-ukraine-moldova-power-system/>

⁴²⁰ Technical conditions (Catalog of measures) were fixed in the Agreement on the conditions for the future unification of energy systems of Ukraine and continental Europe, signed in 2017. The catalog contains more than 200 technical measures in 9 areas. The catalog of activities is an integral part of the Framework Agreement on the Synchronous Area of Continental Europe (SAFA), to which NEC Ukrenergo joins.

⁴²¹

<https://www.entsoe.eu/news/2023/11/28/continental-european-tsos-announce-completion-of-synchronisation-project-with-ukrenergo-and-significant-increase-in-export-capacity-from-continental-europe-to-ukraine/>

⁴²²

<https://ua.energy/zagalni-novyny/entso-e-zbilshyla-obshyag-propusknoyi-spromozhnosti-mizhderzhavnyh-interkonektoriv-dlya-eksportu-elektroenergiyi-z-ukrayiny-ta-moldovy-do-550-mwt/>

⁴²³

<https://www.entsoe.eu/news/2023/03/29/press-release-entsoe-e-announces-further-support-to-ukraine-through-a-new-agreement-on-emergency-energy-assistance-and-increased-electricity-trading-capacity/#:~:text=This%20new%20energy%20agreement%20establishes,generation%20and%20demand%20in%20Ukraine>

determines the following dynamics for the development of the maximum transmission capacity of interconnectors of Ukraine with the ENTSO-E countries for the period until 2050 (Table 4.11).

Table 4.11. Projected development of interconnectors for the exports/imports of electricity (NTC), GW

Capacity of interconnectors (according to scenarios)	Year				
	2024	2030	2035	2040	2050
Optimistic	1.7	4.8	5.0	5.0	5.1
Pessimistic	1.7	4	4.8	4.8	4.8

According to the criterion of the target level of integration of the energy system of Ukraine (interconnectivity) with the energy systems of the ENTSO-E countries (see p. 2.4.1), in accordance with the results of modeling using the TIMES-Ukraine model under the WEM scenario (Table 4.7), the target volume of interconnector capacity of Ukraine in 2030 should be about 3.9 GW, in 2040 – 4.6 GW (10% of the total installed generating capacity in UES of Ukraine). These indicators correspond to TSO estimates regarding the development of interconnectors (Table 4.11), as well as the corresponding target indicators provided for in the Energy Strategy of Ukraine for the period up to 2050.

According to the criterion of the ratio with the peak load in the UES of Ukraine, in accordance with the results of the modeling under the WEM scenario, the amount of the nominal capacity of the interconnectors of Ukraine in 2030 should be about 6.5 GW, in 2040 - 8.3 GW (30% of the peak load in the UES of Ukraine). These indicators generally correspond to the target indicators for the development of interconnectors provided for in the Energy Strategy of Ukraine for the period up to 2050.

According to the criterion of the ratio with the amount of installed generating capacity based on RES in the UES of Ukraine, in accordance with the results of the WEM scenario modeling (Table 4.7), the nominal capacity of interconnectors of Ukraine in 2030 should be about 4.8 GW, in 2040 - 7.2 GW (30% of the total installed generating capacity based on RES in the UES of Ukraine). These indicators generally correspond to TSO estimates for the development of interconnectors through 2030 (Table 4.11), as well as the corresponding target indicators provided for in the Energy Strategy of Ukraine for the period until 2050.

4.5.2. Energy transmission infrastructure

i. Key characteristics of the existing transmission infrastructure for electricity and gas

Electricity infrastructure

The UES of Ukraine is a set of power plants, electric networks, and other electric power facilities united by a common mode of production, transmission and

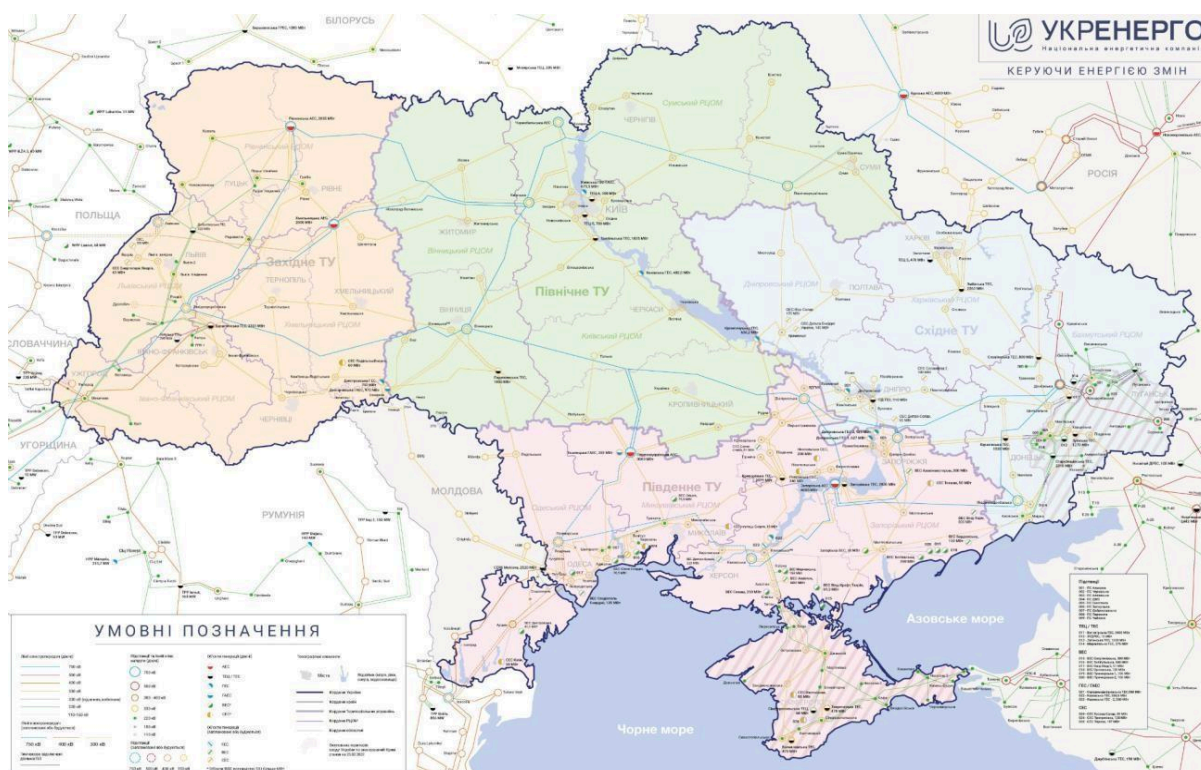
distribution of electricity with centralized control of this mode. The UES of Ukraine is the basis of the country's electricity sector, which provides centralized electricity supply to domestic consumers, interacts with the energy systems of neighboring countries, and ensures the exporting and importing of electricity. It combines generating capacities, distribution networks of the regions of Ukraine, connected to each other by 220-750 kV transmission lines (electricity transmission system).

UES of Ukraine is one of the largest energy associations in Europe; it includes 6 regional power systems and 32 DSOs. Dispatching, balance maintenance in the UES of Ukraine and the organization of synchronous operation with the energy systems of ENTSO-E member countries are performed by the transmission system operator (TSO) NEC Ukrenergo.

System-forming networks with a voltage of 220-750 kV include trunk and cross-border lines. They ensure the production of electricity from powerful units of power plants and its transmission to the distribution networks of the regions of Ukraine (electricity distribution systems), as well as interconnections with the energy systems of neighboring countries. Power transformation is provided using autotransformers and transformers with a voltage of 750/500 kV, 750/330 kV, 500/220 kV, 330/220 kV, 400/330 kV, 330/110(150) kV, 220/110(150) kV, 150/110 kV. As of January 1, 2021, TSO has 21,861.6 km of overhead lines (OHL) in operation along the route, and 23,559.1 km - along chains.

According to the Transmission System Development Plan for 2022-2031, as of the beginning of 2021, there were 141 substations with a voltage of 110-750 kV and a transformer capacity of 83,178.1 MVA on the TSO balance sheet. Substations 220 kV – 33 units, 330 kV – 88 units, 400 kV – 2 units, 500 kV – 3 units, 750 kV – 9 units and 110 kV - 6 units (station nodes of solar power plants). The electricity distribution system included over 1 million km of overhead and cable power lines with a voltage of 0.4-150 kV and about 200,000 transformer substations with a voltage of 6-150 kV.

Fig. 4.29. Map of UES of Ukraine (as of 2023)



The main equipment installed in the transmission system, which operates continuously and determines the reliability and performance of operation, was manufactured mainly in 1950-1970. In terms of basic technical characteristics (weight and dimensions, indicators of reliability and economy, etc.), it is inferior to modern equipment and needs constant repairs. Such a state significantly affects the increase in losses of electricity in the transmission system and limits the possibility of preventing technological violations - damage to electrical equipment or violations of its performance, which leads to a violation of the normal and reliable operation of electric power facilities and UES of Ukraine as a whole.

Technological losses of electricity in trunk and cross-border networks are about 2%. The objective reasons for which losses in the UES of Ukraine remain high include:

- transmission of electricity over long distances, which applies especially to distribution networks;
- unsatisfactory technical condition of electrical networks due to being in operation of worn equipment.

Main equipment with a long operation period is operated at TSO substations (Table 4.12).

Table 4.12. Terms of operation of the main equipment (as of 01.01.2021)

Name of equipment	Power, MVA	Number, units	Including in operation, units			
			up to 25 years old	from 25 to 30 years	from 30 to 40 years	40 or more years
Autotransformers (220-750 kV)	78,450	359	76	49	156	78
Power transformers (35-220 kV)	4,722	106	24	12	26	44
Shunt reactors (35-750 kV)	8,230	109	88	4	14	3
Circuit breakers (35-750 kV)	-	3 326	1 134	260	777	1 115

According to the data given in the table. 4.12, in TSO, 20,792 km of overhead power lines have been in operation for over 30 years (88.0% of the length of all lines), of which 16,344 km have been in operation for over 40 years (69.4% of the length of all lines). This data testify to the tendency of further aging and insufficient pace of reconstruction of power lines, which leads to the complication of their operation by TSO.

Table 4.13. Terms of operation of overhead power lines by voltage (as of January 1, 2021)

Voltage	Total, km		Including those in operation (by chains), km			
	along the route	along the chains	up to 25 years	from 25 to 30 years	from 30 to 40 years	40 or more years
800 kV	98.5	98.5	-	-	-	98.5
750 kV	4,403.2	4,403.2	692.6	-	1,905.4	1,805.2
500 kV	375.3	375.3	38.7	-	159.5	177.1
400 kV	339.0	339.0	-	-	-	339.0
330 kV	13,013.3	13,617.1	1,236.3	460.7	2062.3	9,857.9
220 kV	3,044.3	4,025.7	228.4	-	265.5	3,531.8
110 kV	458.3	568.9	66.4	5.4	42.4	454.7
35 kV	129.7	131.3	36.1	2.5	12.5	80.2
Together	21,861.6	23,559.1	2,298.6	468.5	4,447.7	16,344.3

As a result of changes in climatic conditions in recent decades, a significant number of power transmission lines built in the 1970s and 1980s are vulnerable to increased climatic loads. To a large extent, this is evident in the autumn-winter period in the southern and northern regions of Ukraine (Southern, Dnipro and Northern energy systems). Due to increased loads and the effects of stormy wind, icing, vibration and galloping of wires, the number of damage to the OHL elements has increased significantly and their wear has accelerated. As a result, there was a need for fundamental technical re-equipment and reconstruction of OHL of the specified regions and in general, since the design operational life (40 years) of most of them has already expired.

The need for reconstruction of the 220 kV substation of UES of Ukraine remains urgent, since the operational life of most of them already exceeds 50 years. The annual plans include repairs to the foundations of metal supports, reinforced concrete supports, replacement of lightning protection cable, porcelain insulation and other works aimed at ensuring the reliability of the OHL. At the same time, due to the accelerated wear and tear of the OHL and the impact of increased loads, these works require ever more annual material and labor resources.

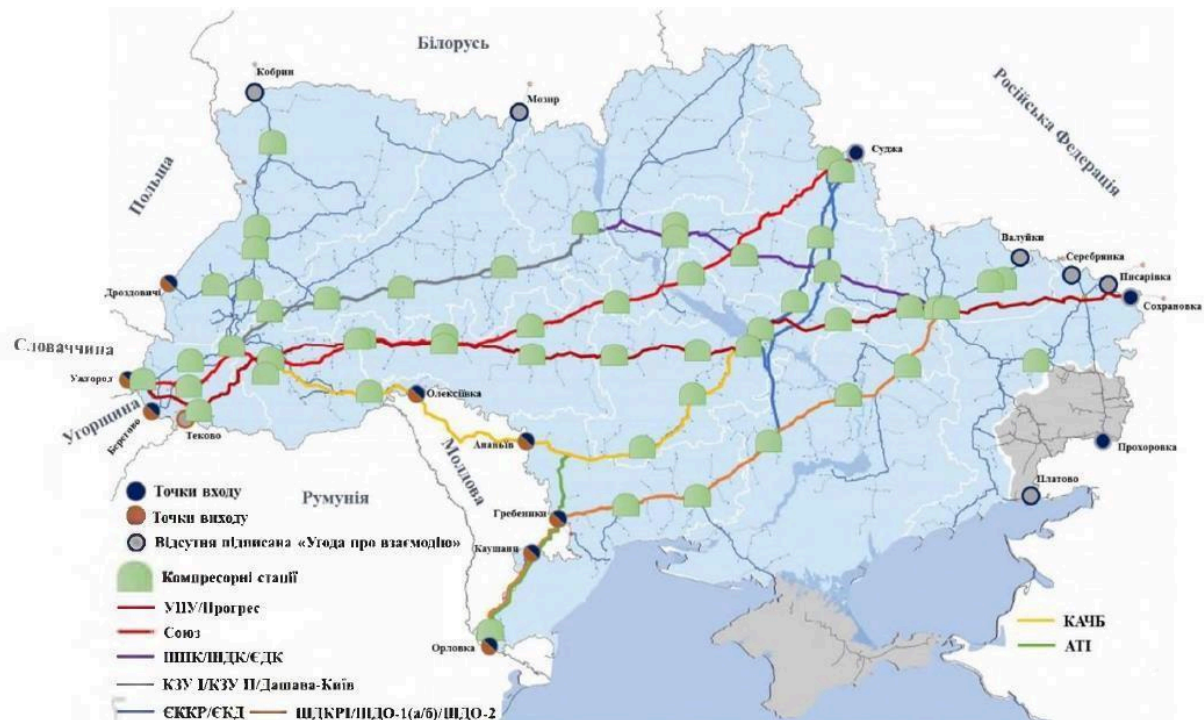
The analysis of financing and implementation of capital repair, technical re-equipment and reconstruction of OHL shows that the amount of restoration does not reduce the existing disparity between wear and tear and restoration and does not fix the issue of considerable wear and tear of networks.

Gas infrastructure

According to the information of "GTS Operator of Ukraine" LLC, the Ukrainian GTS has the following technical characteristics:

- 33,395 km of main gas pipelines,
- 1389 pcs. gas distribution stations,
- 57 pcs. compressor stations.

Figure. 4.30. The main gas pipelines of the GTS of Ukraine

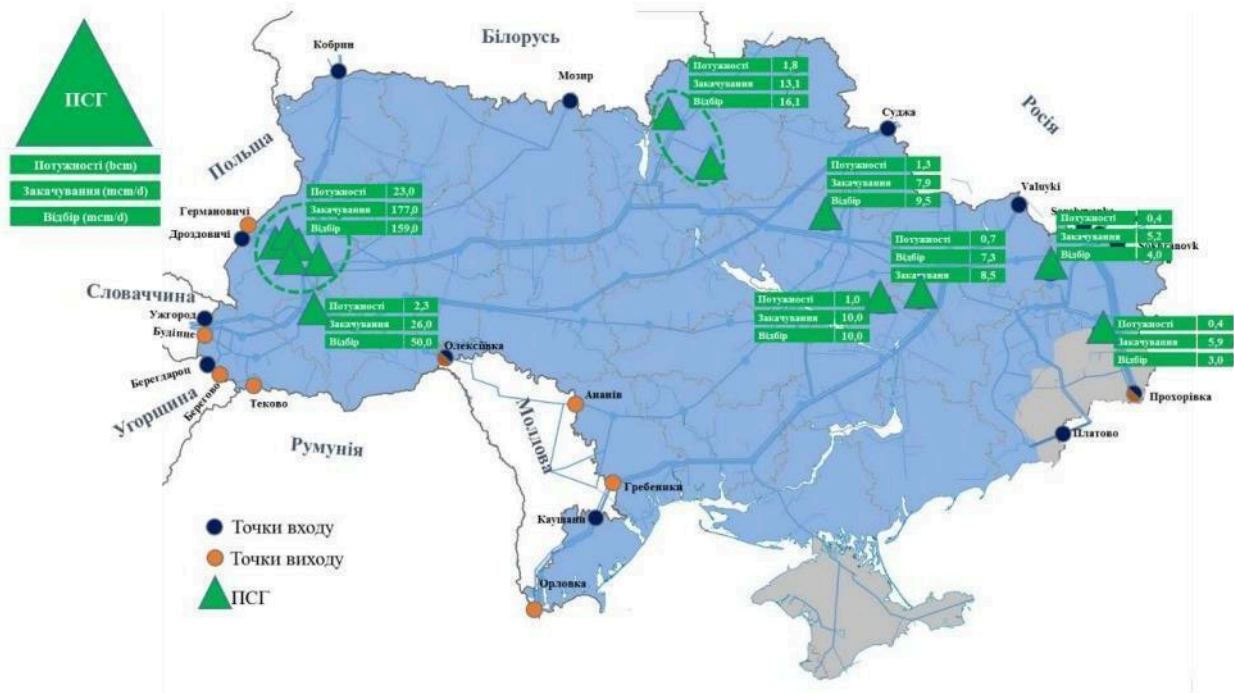


Source: LLC "GTS Operator of Ukraine"

At the same time, the entry capacity of the GTS was 304 bcm, and the exit capacity - 146 bcm. On the European side, GTS has interconnectors with GTS operators from Moldova, Romania, Poland, Hungary, and Slovakia. In general, the amount of capacity on IPs is sufficient to meet current needs, but taking into account the termination of gas transit from the territory of the Russian Federation, it may become excessive.

Ukrtransgaz JSC manages 12 underground natural gas storage facilities, two of which were created on the basis of aquifers, and the rest - on the basis of exhausted gas fields, the total active capacity of which as of the beginning of 2022 was 30.95 bcm. Another gas storage facility is located on the Crimean Peninsula (the operator is the State Joint Stock Company "Chornomornaftogaz").

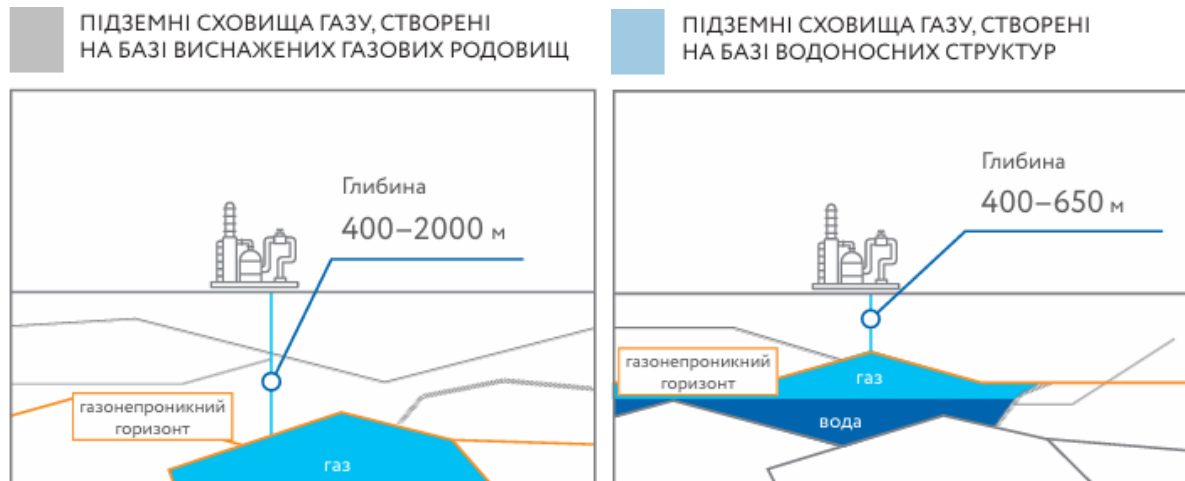
Figure. 4.31. Main characteristics of PSG JSC "Ukrtransgaz"



Source: JSC "Ukrtransgaz"⁴²⁵

According to the geological structure, PSG under the management of JSC "Ukrtransgaz" have the following characteristics:

Figure. 4.32. Geological structure of PSG JSC "Ukrtransgaz"



Source: JSC "Ukrtransgaz"

⁴²⁵ Source – PSG development plan for the period 2021-2030.

ii. Projections of network expansion requirements at least until 2040 (including for the year 2030)

Electricity infrastructure

Forecasts of the needs for the expansion of electrical networks of the transmission system are defined in the Transmission System Development Plan for 2024-2033.⁴²⁶ The decisions of the Development Plan are closely related to the results of the Generation capacity adequacy assessment report. At the same time, in the conditions of the ongoing full-scale military aggression of the Russian Federation, the energy infrastructure facilities suffer significant damage and destruction. Given the high uncertainty of the course and consequences of the war, the results of the generation capacity adequacy assessment may not be relevant. Therefore, after the adoption of documents related to the restoration and development of Ukraine in the electricity sector and related domains in the post-war period, the results of the generation capacity adequacy assessment and regime calculations within the Transmission System Development Plan for 2024-2033 will require revision.

The Transmission System Development Plan for 2024-2033 includes data that, under martial law, may be classified as restricted access information, in particular, information that can identify and characterize critical infrastructure facilities in the energy system of Ukraine.⁴²⁷

The development plan provides for the continuation of the development and modernization of the transmission system in order to eliminate bottlenecks and replace outdated equipment. Regarding the part of the transmission system facilities, where a complex reconstruction with equipment replacement was planned, the postponement of deadlines to later periods is being considered, taking into account emergency and restoration works at such facilities, reallocation of funding for emergency and restoration works, changing the concepts of development and reconstruction of the transmission system facilities in order to physically protect them from missile strikes.

The main factors for the development of electric networks of UES of Ukraine are:

- expansion of interconnectors with the ENTSO-E energy system;
- change of electricity generation and consumption centers;
- extension of the operating period of NPP units under the conditions of positive results of the safety assessment;
- completion of the third, fifth and, in the future, the sixth power units of the Khmelnytsky NPP. The power output scheme of KhNPP during the construction of new units can be estimated only after preliminary calculations of stable and transient modes of operation of the electrical network. Based on the calculations, it is necessary to evaluate the capability of the network to ensure the KhNPP operation in normal, repair and post-accident modes. After the approval of the projects for the construction of units 3, 5 and 6 of the KhNPP and the electricity release scheme, the construction of networks necessary for the appropriate operation of the KhNPP will be considered in the following Development Plans;
- construction of new and reconstruction of existing units at HPPs and HSPs;
- implementation of RES-based generating capacity projects taking into account the needs to optimize the capacity mix in UES of Ukraine;

⁴²⁶ <https://zakon.rada.gov.ua/rada/show/v2634874-23#Text>

⁴²⁷ In connection with the introduction of martial law in Ukraine, the NEURC adopted Resolution No. 349 of March 26, 2022 "On the protection of information that in the conditions of martial law may be classified as information with limited access, including regarding critical infrastructure objects", according to which, during the period of martial law in Ukraine and until the last day of the month following the month of termination or cancellation of martial law, access to information, which in the conditions of martial law can be classified as information with limited access, must be closed, in particular regarding information, which can identify objects of critical infrastructure or create an idea about the potential of the object in the energy system of Ukraine.

- decommissioning of TPP units, electrotechnical and metering network equipment, which have exhausted an operation resource, have unsatisfactory energy efficiency indicators, do not meet environmental and technogenic safety standards;
- increasing the demand for electricity and improving the reliability of electricity supply in powerful electricity nodes and distribution networks in the medium term.

All this leads to the need for the construction of new substations and power transmission lines, reconstruction of existing facilities of the transmission system with an increase in their capacity. The development plan, in particular, envisages the construction of networks that will allow for the provision of additional NPP capacity of up to 2.2 GW. The construction of additional networks is also being considered in order to ensure proper operation of HSPs. In terms of the development of smart grids, TSO will carry out measures within the action plan for the implementation of the 2035 Concept of the implementation of smart grids in Ukraine.

4.5.3. Electricity and gas markets, energy prices

i. Current situation of electricity and gas markets, including energy prices

a) Characteristics of the sector before and during the full-scale invasion of the Russian Federation into Ukraine

Before the start of the full-scale invasion of the Russian Federation (February 24, 2022), Ukraine had excess generating capacity. According to ENTSO-E, as of January 1, 2022, total installed generating capacity was about 54.8 GW.⁴²⁸ The TSO Ukrenergo NEC estimated the installed capacity at the level of about 56.5 GW. The total generating capacity was over 2.5 times higher than the maximum level of demand (electrical load) observed in the winter period in the UES of Ukraine during 2016-2022 – about 21-22 GW.⁴²⁹ Such excess capacity provided significant production potential for electricity exports, in particular to EU countries, which was mainly limited by the capacity of interconnectors.

In 2021, the installed capacity mix was dominated by coal generation, however, nuclear energy traditionally dominated electricity production mix.

Figure. 4.33. Installed capacity mix (2021)

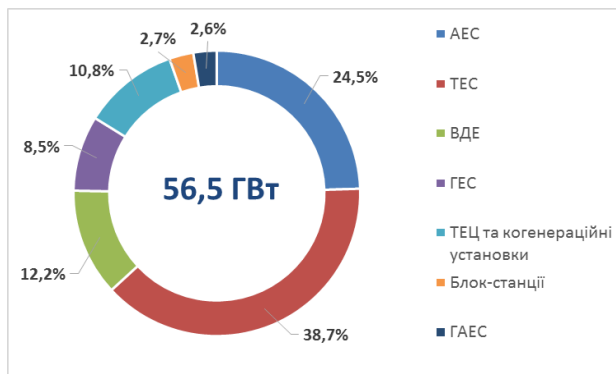
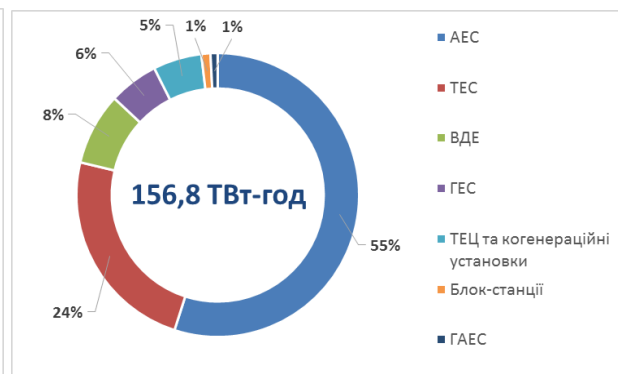


Figure. 4.34. Production mix (2021)



⁴²⁸ <http://bit.ly/3ZCPf9S> (ENTSO-E)

⁴²⁹ <https://www.iea.org/data-and-statistics/data-tools/ukraine-real-time-electricity-data-explorer>

The full-scale invasion of Ukraine had a significant impact on the electricity sector. On the one hand, Ukraine was able to prove a high level of sustainability and resilience of the energy system by the operation for three weeks in an isolated mode and joining ENTSO-E, and in June - by starting commercial electricity exports to the EU.

On the other hand, massive missile and drone attacks on energy infrastructure caused significant destruction and damage to generation facilities and electrical networks. Most of the power plants were under occupation - in particular, Zaporizhzhia NPP (6,000 MW), Luhansk, Zaporizhzhia and Vuhlehirsk TPPs (about 7,700 MW). Kakhovka HPP (343 MW) was blown up and completely destroyed. There are CHPs (with a total capacity of about 490 MW), a large part of wind (WPP) and solar (SPP) power plants, as well as coal mines⁴³⁰ in the territories not controlled by Ukraine. Due to the loss of a significant part of the generation and its transmission capacities in the energy system, Ukraine suspended the exports of electricity to the EU countries in the period from October 11, 2022 to April 2023. Since March 2024, Russia has resumed large-scale combined attacks on the energy infrastructure of the UES of Ukraine, focusing them primarily on flexible generation - TPPs and HPPs. A number of large CHPs of regional importance were also destroyed.

Due to the large-scale migration of the population abroad and the reduction of production and business activity, the demand for electricity in the power system decreased by approximately 30-35%. Despite this, in conditions of occupation and destruction of energy facilities, the remaining generation potential is insufficient to cover domestic demand in full.

Large-scale scheduled and emergency power outages are applied by TSO and DSOs to stabilize the grid. Also, to cover the internal electricity deficit, the government has started work on the creation of special financial and economic mechanisms, which, taking into account the difference in electricity prices in the countries of Eastern Europe and Ukraine, will ensure affordability of importing electricity from EU countries.

b) Structural organization and functioning of the electricity market

Ukraine's electricity market, similar to European markets, include six main segments:

- bilateral contracts market (BCM),
- day-ahead market (DAM),
- intraday market (IDM),
- balancing market (BM),
- auxiliary service market (ASM),
- retail market.

⁴³⁰ https://www.energycharter.org/fileadmin/DocumentsMedia/Occasional/2022_11_24_UA_sectoral_evaluation_and_damage_a_assessment_Version_IV.pdf

The operation of the markets is determined by the rules approved by the Regulator. The largest part of electricity is traded through BCM - in 2022, the total trading volume was about 135.5 TWh.⁴³¹ Around 18.2 TWh was traded through DAM (-49.1% compared to 2021), and 2.7 TWh was traded through IDM (-46.7% compared to 2021).⁴³² In 2023, compared to 2022, the total volume of trading electricity in DAM increased by 14% to 20.8 TWh, but did not reach the pre-war level. 1.7 TWh were traded on the IDM (-38.5% by 2022). The total cost of electricity purchased at the Market Operator platform (DAM and IDM) was UAH 81.5 billion (without VAT). In 2023, 119 new companies became members of DAM and IDM. As of December 31, 2023, there were 573 contracts for participation in DAM/IDM with energy companies trading on the Market Operator platform. The coefficient of market concentration (CR5) on DAM showed a high level among buyers - on average 77%, among sellers - 74%.⁴³³

Article 66 of the Law of Ukraine "On the Electricity Market" (as amended by the Law of Ukraine "On Amendments to Certain Laws of Ukraine Regarding the Restoration and Green Transformation of the Energy System of Ukraine" No. 3220-IX of June 30, 2023) defines certain restrictions regarding conclusion of bilateral agreements. In particular, producers of electricity (except producers of electricity from alternative energy sources (except blast furnace and coke gases, and with the use of hydropower - only micro-, mini- and small HPPs) trade electricity under bilateral contracts exclusively at electronic auctions, the procedure for conducting which are approved by the Cabinet of Ministers of Ukraine. Producers of electricity from alternative energy sources (except for blast furnace and coke gases, and using hydropower - only micro-, mini- and small HPPs) have the right to trade electricity under bilateral contracts at electronic auctions on a voluntary basis.

Trading in BCM takes place through the electronic platform of Ukrainian Energy Exchange LLC (UEX),⁴³⁴ since according to the results of the competitive selection of organizers of electronic auctions for trading electricity under bilateral contracts, UEX received the first priority right to organize and conduct auctions.⁴³⁵

At the same time, the price-making segment is deemed DAM, whose price quotations are mainly used to determine the electricity prices on BCM (as a rule, with a discount of 5-10% from DAM). It is worth noting that the prices in DAM and IDM, as well as the balancing market, are regulated via price caps. Taking into account the dynamics of the market, during 2022-2023, the Regulator revised the price caps for these market segments several times. The price caps for DAM, IDM and the balancing market are (as of June 1, 2024):

- maximum prices (caps) from 00:00 to 07:00 and from 11:00 to 17:00 – 5,600 UAH/MWh; from 07:00 to 11:00 and from 23:00 to 24:00 – 6,900 UAH/MWh; from 17:00 to 23:00 – 9,000 UAH/MWh;
- minimum price (floor) – 10 UAH/MWh;

⁴³¹ <https://www.nerc.gov.ua/monitoring-rinku-elektrichnoyi-energiyi/operativnij-monitoring-rinku-elektrichnoyi-energiyi/informaciya-shchodo-zdijsnennya-kupivli-prodazhu-elektrichnoyi-energiyi-za-dvostoronnimi-dogovora-mi/torgivlya-za-dvostoronnimi-dogovorami-vcilomu>

⁴³² <https://www.oree.com.ua/index.php/web/10538>

⁴³³ <https://www.oree.com.ua/index.php/newsctr/n/22129>

⁴³⁴ <https://www.ueex.com.ua/auctions/electricenergy/>

⁴³⁵ http://mpe.kmu.gov.ua/minugol/control/uk/publish/article?art_id=245396800&cat_id=35109

in the balancing market:

- the maximum price from 00:00 to 07:00 – 6,600 UAH/MWh; from 07:00 to 17:00 and from 23:00 to 24:00 – 8,250 UAH/MWh; from 17:00 to 23:00 – 10,000 UAH/MWh;
- the minimum price is 0.01 UAH/MWh.⁴³⁶

Figure. 4.35. Price caps on DAM and IDM by periods of the day (from June 1, 2024)



According to Market Operator, which administers the DAM and IDM, during the twenty-month period from March 2022 (the start of synchronized operation of the UES of Ukraine and the ENTSO-E systems) to November 2023, the price caps had a significant impact on the DAM, since in 35% of the settlement periods, the hourly prices for DAM were at or close (with a difference of under 1%) to the established price caps of the corresponding settlement period for this market segment. At the same time, after revision by the Regulator of price caps, for the period of December 2023 - April 2024, the number of such cases (hourly settlement periods) decreased significantly - to 8.6%.⁴³⁷

A comparison of price dynamics on the DAM of Ukraine and neighboring EU countries (Poland, Hungary, Slovakia and Romania) shows a relatively low level of convergence. The main reasons for this phenomenon

⁴³⁶

<https://www.nerc.gov.ua/news/20-travnya-2024-roku-vidbulosya-zasidannya-NEURC-prodovzhennya-zasidannya-NEURC-vid-17052024>

⁴³⁷ https://www.oree.com.ua/index.php/control/results_mo/DAM

are 1) insufficient capacity of interconnectors, 2) lack of integration of Ukraine's spot markets with EU markets and 3) regulation of DAM prices by the Regulator by applying price caps. In 2020-2024,⁴³⁸ the difference between the daily Base DAM price indices in the vast majority of periods (days) is higher than 2 EUR/MWh (relative to Poland - in 97.0% of periods, Romania - 94.1%, Slovakia - 93.9%, Hungary - 94.9%). The average daily difference of Base DAM indices of Ukraine relative to the markets of Poland was 39.6 EUR/MWh, Romania - 66.2 EUR/MWh, Slovakia - 65.6 EUR/MWh, Hungary - 68.9 EUR/MWh.⁴³⁹

According to Market Operator, at the end of the first half of 2022, there were 523 market participants with active status operating on DAM and IDM. Among them: 37 - electricity producers, 31 - distribution system operators (DSOs), 459 - suppliers, 27 - traders, 5 - large consumers, TSO (NEC Ukrenergo) and guaranteed buyer⁴⁴⁰. At the same time, as of the end of April 2024, the number of participants of the DAM and IDM with an active status increased to 581 (+11.1%).⁴⁴¹ The specifics of the activity on the DAM and IDM during the period of martial law is that suppliers and traders are prohibited from selling electricity in these market segments. Thus, the main sellers are generating companies and a guaranteed buyer that sells electricity produced from RES.

Trading on BCM takes place in the form of auctions through the UEX platform⁴⁴² or on the over-the-counter segment. At the same time, state-owned generating companies are obliged to sell the entire amount of electricity under bilateral contracts through UEX in accordance with the approved Auction Procedure.⁴⁴³ The BCM prices are not regulated and are determined based on the results of auctions.

At the same time, it is worth noting that a significant amount of electricity is actually "removed" from the competitive market, as it is sold according to regulated procedures within the mechanism of imposing public service obligation (PSO) introduced by the government.⁴⁴⁴ Its main goal is to keep electricity price for households affordable, which is one of the lowest in Europe.

c) Regulation of cross-border trade

Electricity exports from Ukraine is built on the basis of explicit⁴⁴⁵ auctions for the allocation of access of potential exporters (producers, traders, suppliers) to cross-border transmission capacity.⁴⁴⁶ Available capacity in the directions of Poland, Romania, Hungary, Slovakia and Moldova is determined by NEC Ukrenergo, based on the technical capabilities of interconnectors and in cooperation with ENTSO-E.⁴⁴⁷ One of the areas of activity of NEC Ukrenergo is providing market participants with access to interconnectors

⁴³⁸ The period during 2024, which was considered in the analysis of electricity prices for the Russian Federation, includes January-April 2024.

⁴³⁹ <https://map.ua-energy.org/uk/resources/5bee4464-ba9f-4117-a4ca-f71584bd5f54/>

⁴⁴⁰ <https://www.oree.com.ua/index.php/web/10431>

⁴⁴¹ <https://www.oree.com.ua/index.php/main/register>

⁴⁴² <https://www.ueex.com.ua/auctions-calendar/elektrichna-energiya/>

⁴⁴³ <https://zakon.rada.gov.ua/laws/show/499-2019-%D0%BF#Text>

⁴⁴⁴ <https://zakon.rada.gov.ua/laws/show/483-2019-%D0%BF#Text>

⁴⁴⁵ An open auction involves only the allocation of access to cross-border capacity, but not the actual commercial volume of electricity that will be moved across the interstate crossing pursuant to contracts or auctions.

⁴⁴⁶ Capacity of interconnectors of the UES of Ukraine – the technical possibility of ensuring the supply of electricity through the interstate crossing in a certain direction, taking into account maintenance plans and repairs of energy equipment of the UES of Ukraine and energy systems of neighboring countries.

⁴⁴⁷ <https://eap-office.ua.energy/pages/bandwidth/public-ntc>

of Ukraine. Access is provided at joint coordinated auctions for the allocation of interconnector capacity.

Since May 2017, an electronic platform for conducting auctions for the interconnector capacity allocation has been implemented, which includes all the information on conducting auctions. NEC Ukrenergo, as a TSO, conducts annual, monthly and daily auctions for the allocation of access for exporting and importing electricity, at which the available interconnector capacity is allocated among the participants of the auctions on a competitive basis. Export and import auctions are transparent, and their schedule and results are regularly published on the operators' online platform.⁴⁴⁸

The companies participating in the auctions must conclude an agreement with NEC Ukrenergo on participation in auctions on allocation of interconnector capacity for the corresponding year.⁴⁴⁹ As of January 12, 2023, the list of registered NEC Ukrenergo companies for potential participation in auctions included 242 participants.⁴⁵⁰ However, there are significantly fewer active participants. Thus, during July-September 2022, up to 12-13 companies (primarily traders and producers) participated in daily auctions for exporting electricity to Romania, Slovakia, and Poland, ensuring intense competition and high prices for access to interconnectors. According to the auction results, the companies purchased electricity on the wholesale market (primarily under bilateral contracts (on BCM) or on DAM and exported on the basis of bilateral contracts with counterparties from EU countries and Moldova.

Also, amendments were made to the Law of Ukraine "On the Electricity Market", which introduced a new scheme for the distribution of income of NEC Ukrenergo from auctions for the allocation of interconnector capacity.⁴⁵¹ Before the adoption of these amendments, all income received by NEC Ukrenergo at auctions was to be directed exclusively to investments in the technical development of cross-border networks. Taking into account the amendments to the Law of Ukraine, from August 1, 2022 to January 1, 2023, the TSO had to transfer 50% of the revenue from auctions to cover debts accumulated on the balancing market of electricity (to balancing service providers and other market participants responsible for balancing) and 50% to the guaranteed buyer for further allocation of the relevant funds to Energoatom and producers of electricity from RES to cover debts.⁴⁵² In addition, TPPs and CHPs, which provide balancing services, were supposed to spend the funds received from NEC Ukrenergo exclusively for the purchase of fuel (primarily, steam coal, natural gas, or fuel oil) or maintenance of equipment to ensure the proper operation of generating capacities during of the 2022-2023 heating season.

From October 11, 2022, export auctions and commercial electricity exports were suspended due to the emergence of a significant deficit in the energy system of Ukraine as a result of targeted and systematic attacks by the Russian Federation on the energy infrastructure of Ukraine (generating capacities and networks). Auctions were resumed by TSO in 2023.

Natural gas market

In connection with the full-scale invasion of the Russian Federation in Ukraine from February 2022, as well as taking into account the measures taken to counter its destructive consequences, the development of the gas market and its competition have slowed down significantly.

⁴⁴⁸ <https://eap-office.ua.energy/pages/dashboard>

⁴⁴⁹ https://ua.energy/wp-content/uploads/2022/12/Nakaz_616_-na-2023-rik.pdf

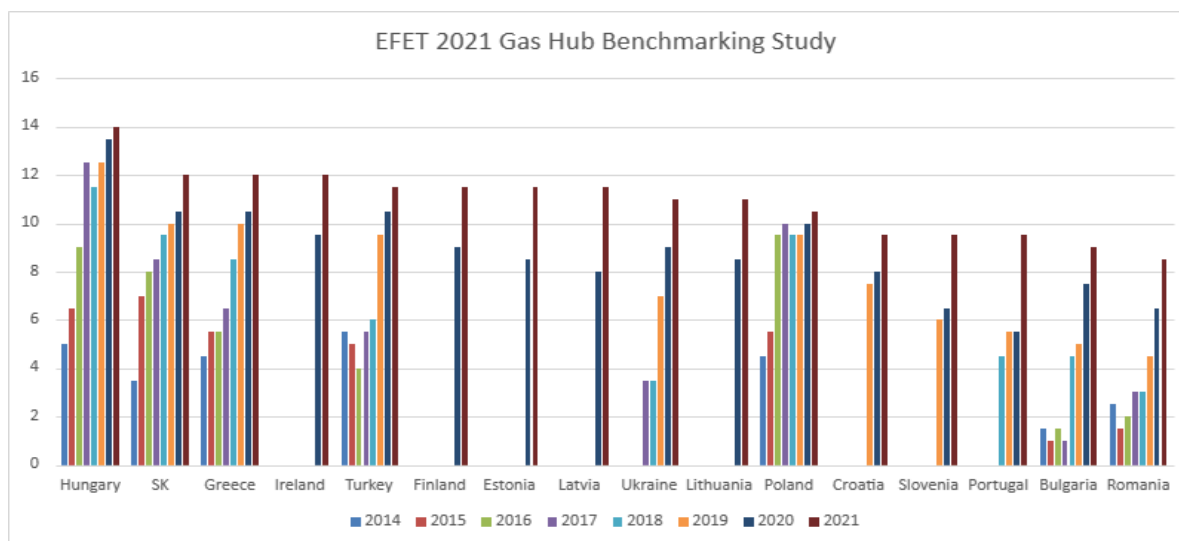
⁴⁵⁰ <https://ua.energy/wp-content/uploads/2023/01/Revestr-uchasnykiv-vid-12.01.23.xlsx>

⁴⁵¹ <https://zakon.rada.gov.ua/laws/show/2479-IX#Text>

⁴⁵² https://www.gpee.com.ua/news_item/1086

At the same time, in previous years, starting from 2014, the gas market of Ukraine developed significantly and became part of the European energy market. In particular, according to the comparison of European gas hubs conducted by EFET (European Federation of Energy Traders) in 2021,⁴⁵³ Ukrainian gas hubs had fairly high indicators of development and stable growth dynamics.

Figure. 4.36. Benchmarking of gas hubs (2021)



Source: EFET

ACER assessed the situation on the gas market of Ukraine in a similar way. The 2020 wholesale gas market monitoring report notes that in 2020 the volume of trades on the Ukrainian Energy Exchange increased to 2 billion m³ (from 0.3 billion m³ in 2019), and the number of bidders doubled. Most trades were for month-ahead products, but day-ahead trades were also planned. Most of the liquidity was created by the Naftogaz Group, which could increase the volume of trades on this platform after reducing the volume of PSOs assigned to it.⁴⁵⁴

From February 2022, the consumption of natural gas, in particular by industry, was significantly reduced, and the export of natural gas was prohibited, which created negative incentives for the development of extraction by private companies. In addition, a significant part of consumers receive gas at fixed prices.

In particular, the legally established moratorium on price increases above the level in effect as of February 24, 2022 applies to household consumers, associations of co-owners of apartment buildings, housing and construction cooperatives, other persons authorized by co-owners in accordance with the law who through self-sufficiency maintain autonomous heat supply systems of an apartment building owned by co-owners with the right of joint co-ownership in an apartment building, in their interests conclude contracts for the supply of natural gas for the operation of gas boilers (rooftop, attached and/or those located on the territory of the house) to ensure needs of co-owners of an apartment building (except for non-residential premises), heat energy producers - if they use natural gas for the production of heat energy for the population and have entered into an agreement with a natural gas market entity on which in accordance with the first part of Article 11 of the Law of Ukraine "On the Natural Gas Market gas" PSOs are imposed.

⁴⁵³ <https://www.efet.org/home/documents?id=19>

⁴⁵⁴ ACER Market Monitoring Report 2020 – Gas Wholesale Market Volume, 14/7/2021.

In the case of household consumers, this price is UAH 7,960/thousand m³ (with VAT). In the context of the supply of natural gas to household consumers, the Regulation on imposing special obligations on natural gas market entities to ensure public interests in the process of functioning of the natural gas market, approved by Resolution of the Cabinet of Ministers of Ukraine of March 6, 2022 No. 222 (Official Gazette of Ukraine, No. 25, No. 2080, No. 4492, No. 2, No. 4856 2024, No. 154, No. 388; 2024, No. 2307)⁴⁵⁵ applies. In the context of the supply of natural gas to thermal energy producers, including associations of co-owners of apartment buildings, housing and construction (housing, service) cooperatives, managers of apartment buildings, until April 15, 2024, the Regulation on imposing special duties on sub entities of the natural gas market to ensure public interests in the process of functioning of the natural gas market regarding the specifics of natural gas supply to thermal energy producers and budget institutions, approved by Resolution of the Cabinet of Ministers of Ukraine of July 19, 2022 No. 812 (Official Gazette of Ukraine, 2022, No. 59, Article 3727, Article 2547, Article 92, Article 8, Article 388, Article 672; 2024, Article 2308) applies.⁴⁵⁶

Table 4.14. Prices according to PSO provisions (as of May 2024)

Consumer category	Price, UAH/m ³ with VAT	Legal basis	Calculation formula (if any)	Validity period
Household consumers (Naftogaz Group)	7.96	Law on moratorium	fixed price (the supplier's basic offer as of 02/24/2022)	6 months after the end of martial law
Gas suppliers for household consumers	7.24	PSO Regulation #222	the basic annual offer of the supplier minus the trade allowance (markup) UAH0.6/m ³	31.08.2024
DHCs for categories:				
population (within the fixed volume I), including budgetary institutions - producers of heat for households	7.42	PSO Regulation #812	fixed price (in the PSO Regulation)	31.08.2024

⁴⁵⁵ <https://zakon.rada.gov.ua/laws/show/222-2022-%D0%BF#n31>

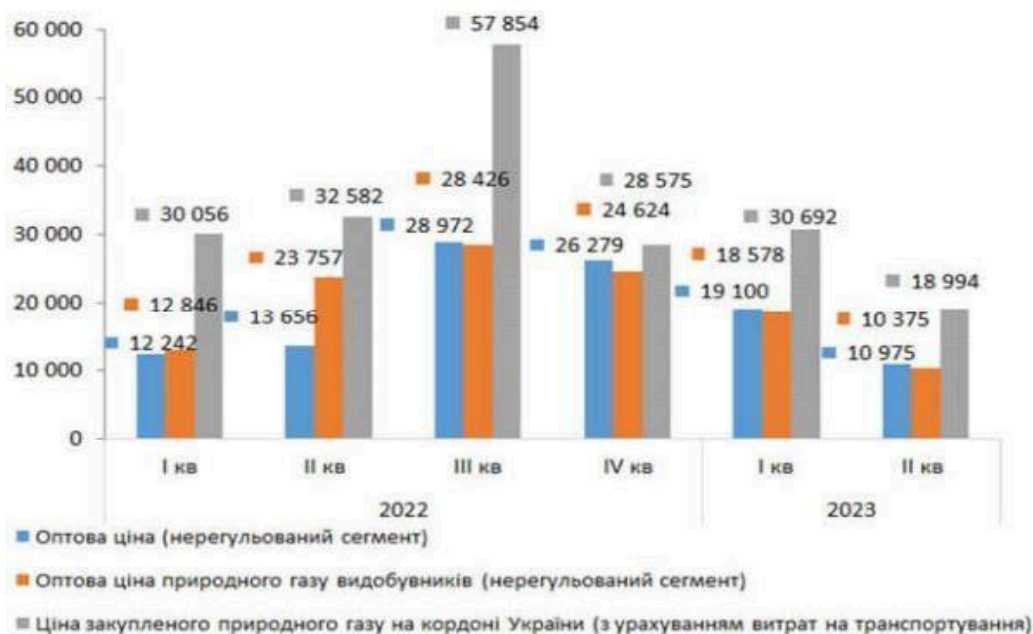
⁴⁵⁶ <https://zakon.rada.gov.ua/laws/show/812-2022-%D0%BF#n34>

budgetary institutions, religious organizations, enterprises of the State Government (within the fixed volume III)	16.39		fixed price (in the PSO Regulation)	
other consumers (within floating volume II)	Calculated according to the formula		the formula is based on the weighted average price for the resource of the month preceding the month of natural gas supply and was developed based on the results of electronic stock exchange trading on the Commodity Exchange “Ukrainian Energy Exchange”	
Hostels	7.42	PSO Regulation #812	fixed price (in the PSO Regulation)	31.08.2024
Budget institutions and religious organizations	16.39	PSO Regulation #812	fixed price (in the PSO Regulation)	31.08.2024
Electricity producers:				
TPP (condensing)	10.95	PSO Regulation #222	fixed price (in the PSO Regulation)	31.08.2024
CHP	16.5		fixed price (in the PSO Regulation)	
Gas turbine and gas piston installation	16.5		fixed price (in the PSO Regulation)	
GDSOs:				
Normative technological losses (volume I)	7.42	PSO Regulation #222	fixed price (in the PSO Regulation)	within 6 months after the end of martial law
Technological losses beyond normative (except "war losses") (Volume II)	Calculated according to the formula		the formula is based on the price of gas on the Slovak market, taking into account delivery to Ukraine	
"War Losses" ("Losses caused by military actions and incurred in connection with the prevention/resolution of humanitarian crisis situations") (Volume III)	0.01		fixed price (in the PSO Regulations)	

Considering such a perimeter of PSO provisions and other factors, only insignificant volumes are traded on the open market, evidence of which is information from existing trading platforms, such as

the "Ukrainian Energy Exchange". According to the SEEGAS initiative, in 2022 the volume of trading on this main gas exchange amounted to 167.45 million m³.⁴⁵⁷ According to the NEURC, there is a significant difference between gas prices at the border (taking into account transportation costs) and gas prices sold on the domestic market by producers⁴⁵⁸.

Figure. 4.37. Wholesale prices for natural gas



Source: NEURC

In general, according to the NEURC data, in the I and II quarters of 2023, 180 and 168 suppliers (respectively) were engaged in the supply of natural gas, of which 13 companies also supplied natural gas to household consumers. In both quarters, 97% of natural gas supplies to the population were carried out by Gas Supply Company Naftogaz of Ukraine LLC.

In terms of protecting vulnerable consumers and combating energy poverty, according to the data of the National Economic Strategy until 2030, a significant part of the household budget falls on utilities. Expenditures for utilities in 2019 accounted for more than 13% of total household expenses, which is one of the significant components of the budget of households. In Ukraine, the average level of energy poverty is, according to various sources, from 11% (according to the State Statistics Service) to 13-18% (according to the Energy Community). According to the Self-Assessment by Households of the Availability of Certain Goods and Services in 2021, 15.4% of households did not have enough funds for timely and full payment of housing bills and necessary services for its maintenance or gas for cooking, and 17.2% for maintenance of warm enough temperature in their home during the heating season.

⁴⁵⁷ <https://www.energy-community.org/regionalinitiatives/SEEGAS.html#pouqyh-accordion>

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https://www.nerc.gov.ua/storage/app/sites/1/Docs/Sfery_Gaz/Monitoring_rynku_gaz/2023/monitoryng_gaz_II-2023_.pdf

Energy use in transport

The use of energy in transport requires a separate review (separate from the review of the state of the electricity and natural gas markets), given the diversity of modes of transport and the types of energy products used in different vehicles. This review is also necessary to provide context for the development of related infrastructure: both fossil fuels (particularly oil and petroleum products) and charging infrastructure for electric vehicles.

EU statistics⁴⁵⁹ defines two categories of transport: freight and passenger. Under freight transport, the following are distinguished:

- land transport (road transport, railway transport, pipeline transport);
- water transport (sea transport, inland water transport);
- air transport.

Under passenger transport, the following are distinguished:

- land transport (road transport, railway transport); at the same time, road passenger transport is carried out by passenger cars, motorcycles and mopeds, as well as buses;
- water transport (sea transport, inland water transport);
- air transport.

Since the beginning of 2022, in connection with the full-scale invasion of the Russian Federation into Ukraine, sea, inland water and air traffic has significantly decreased on the territory of Ukraine.

JSC "Ukrzaliznytsia" is a joint operator of railway transport. The main types of energy products used by JSC "Ukrzaliznytsia" for train traction are diesel fuel and electricity.⁴⁶⁰

In Ukraine, the following types of energy products are used for road transport needs:

- Gasoline;
- Diesel fuel (DF);
- Liquefied petroleum gas (LPG);
- Compressed natural gas (CNG);
- Electricity.

⁴⁵⁹ Eurostat, Key figures on European transport, 2022 edition , [Key figures on European transport – 2022 edition \(europa.eu\)](https://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&plugin=1)

⁴⁶⁰ https://www.uz.gov.ua/press_center/up_to_date_topic/page-3/618680/

Liquefied natural gas (LNG) is currently not used for transport needs. At the same time, according to a 2020 study commissioned by the European Commission, the use of LNG for long-distance road freight transport, as well as potentially for rail transport, may be promising.⁴⁶¹

Partly gasoline, diesel fuel, as well as autogas (LPG, CNG) are produced in Ukraine; however, most of the required volumes are imported. According to Naftorynok, in 2023 the number of importers of DF was 652, compared to 657 in 2022. During 2023, 24% more DF was imported than in 2022, and the main importers were the OKKO, WOG and UPG group companies, which together provided almost 30% of the volume of imported DF⁴⁶². At the same time, from February 24, 2022, the number of issued licenses (based on the location of the applicant) for wholesale fuel trade in the absence of sales outlets increased by 589 units compared to 2019-2021 - the beginning of 2022, up to 1,862⁴⁶³. In addition, from February 2022 to November 2023, 104 new gas stations began operating on the territory of Ukraine: 45 in 2022 and 59 in 2023⁴⁶⁴.

Figure. 4.38. Prices for petroleum products at Ukrainian gas stations during 2023



Source: Institute of Car Market Research

According to the Main Service Center of the Ministry of Internal Affairs, as of January 1, 2023, the total number of passenger electric cars registered in Ukraine is 46,830 cars. In 2022, 13,321 passenger electric cars were registered for the first time by service centers of the Ministry of Internal Affairs, which is 56% more compared to the previous year. At the same time, in 2023, more than 37,000 electric cars were registered.

⁴⁶¹ https://energy.ec.europa.eu/publications/prospects-lng-markets-eastern-partner-countries_en

⁴⁶² <https://www.neftorynok.info/novosti/upg-okko-ta-wog-mportuvali-tretinu-dizpalnogo-u-2023-r>

⁴⁶³ <https://www.neftorynok.info/novosti/klkst-vidanih-optovih-lcenzy-zroslo-na-46-u-2022-2023-rr>

⁴⁶⁴ <https://www.neftorynok.info/novosti/z-pochatku-povnomasshtabnogo-vtorgnennya-zapracyuvali-104-novih-azs>

Figure. 4.39. The dynamics of the increase in the number of electric vehicles



ii. *Projections of development with existing policies and measures at least until 2040 (including for the year 2030)*

Electricity market

Among the key factors that will determine the situation on the electricity market of Ukraine and the potential of foreign trade after the cancellation or termination of martial law, it is worth highlighting the following:

1. the extent of damage and destruction of generation facilities and electrical networks, which will determine the volume, composition, flexibility of electricity supply, as well as the level of prices in the domestic market;
2. dynamics of recovery of economic activity and socio-demographic dynamics in the country, which will determine the volume and composition of demand for electricity, as well as the consumption profile (load curve);
3. price cap regulation and other types of regulation in wholesale market segments;
4. the policy of bringing electricity prices for households to a market-based level along with the gradual minimization of PSO and increasing the supply of electricity in the competitive market;
5. deepening integration with the markets of EU countries (increasing cross-border capacity and integration), in particular, by combining day-ahead and intraday markets (market coupling) with Eastern European countries (Poland, Romania, Slovakia, Hungary and Moldova).

Taking into account the factors of significant inflation, we can expect a gradual increase in the level of marginal prices (price caps) of electricity in the wholesale market segments (DAM, IDM and balancing market). The revision of price caps may cause a corresponding increase in wholesale electricity prices, including in the BCM segment, which yet focuses on DAM reference price quotes.

Prices for households remained at the current level until the end of the 2023/2024 heating season. Their upward revision during the martial law in Ukraine is possible - provided there is a slight multi-stage increase over time (at least for 2-3 years). The Cabinet of Ministers of Ukraine will adopt the Roadmap for the gradual liberalization of the gas and electricity markets with the steps to be taken and the corresponding terms to be implemented after the end of martial law. The roadmap will be based on technical analysis to understand the financial state of the sector.

As part of the deepening of the European integration of markets, Market Operator joined the Committee of European Market Operators (NEMO Committee) in the status of an observer of the operation of the EU spot electricity market - SDAC (single day-ahead coupling) and SIDC (Single Intraday Coupling). The status of the observer allows to start the technical preparation for the coupling of the spot markets of Ukraine and European countries.⁴⁶⁵

The planned interconnectors' development of UES of Ukraine with the ENTSO-E energy system and Ukraine's full participation in the coupled spot markets of Eastern European countries will expand the opportunities for the development of cross-border electricity trade, which will be limited by the available capacity of interconnectors. As a result, a gradual convergence of prices on the wholesale electricity market of Ukraine and the markets of Eastern European countries is expected. The directions, time periods and volume of cross-border trade will be determined depending market conditions on the coupled electricity markets. In addition, the possibility of exporting electricity from Ukraine to the EU countries will be influenced by the factor of application or avoidance of the CBAM.

Natural gas market

Existing policies and measures generally do not allow achieving all the goals defined for the "Internal energy market - gas" dimension.

First, the presence of restrictions on the export of both natural gas and biomethane significantly limits domestic production and distorts prices on the domestic market. In the context of biomethane, this ban reduces the pressure on the sector to overcome other problems faced by biomethane producers (for example, problems with access to networks): in the case of the opening of exports, these problems would become more urgent and their resolution would be accelerated.

Secondly, the presence of price restrictions (under PSO regulations) for a large number of consumers also does not encourage an increase in production, including due to the development of new technologies and the search for synergies. In addition, such restrictions - against the background of reduced consumption due to military actions - lead to the weakening of competition due to a decrease in the volume of imports and importers who usually compete with sellers of gas from their own production.

Thirdly, without the introduction of additional measures, the working conditions in the domestic gas market are difficult and onerous for new players. This concerns the uncertainty regarding the fate of the property and assets of the GDS, the insufficient level of their unbundling from the interests of supply and production, as well as the lack of guarantees of adequate financing, which has a significant impact on the operation of the retail market. Dependent on this are also the problems of balancing rules and the lack of a comprehensive system of commercial gas accounting (on the background of insufficient equipment of consumers with metering devices), which, under existing policies and measures, do not allow suppliers to independently

⁴⁶⁵ <https://www.oree.com.ua/index.php/newsctr/n/17286>

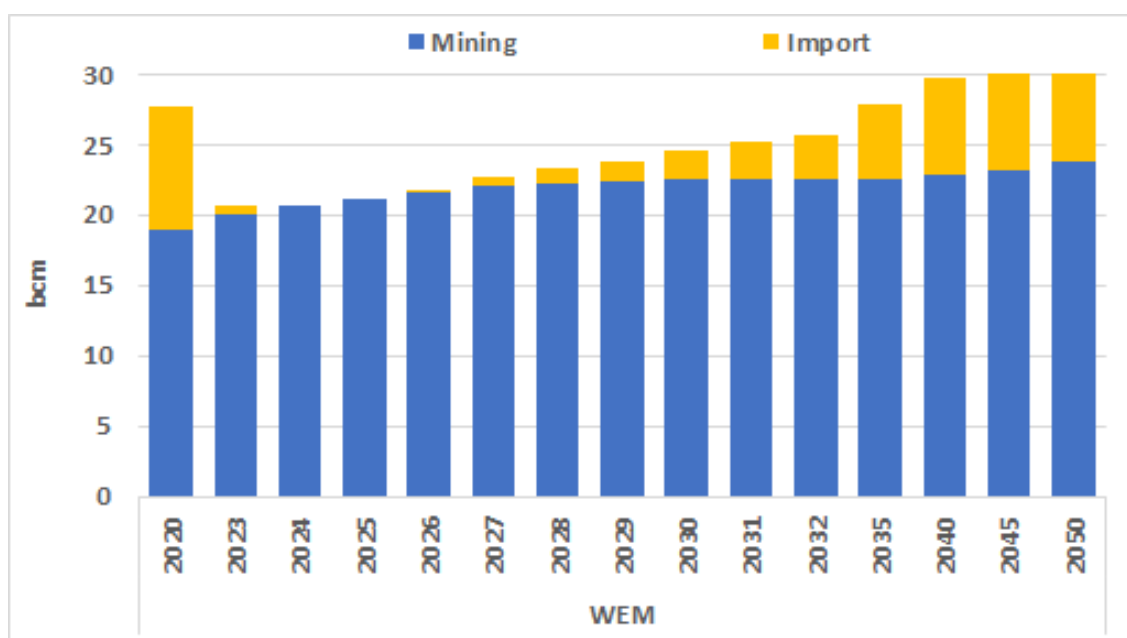
manage their gas supply risks, especially to household consumers. At the same time, the quality of the market functioning should be reflected in the increase in competitive offers which household consumers can receive.

Existing policies and measures on the infrastructure sub-dimension are generally adequate to ensure sufficient connection of the gas networks of Ukraine and the EU (in terms of planning and identifying market demand, creating new products). At the same time, they are not sufficient for proper adaptation of these networks to the requirements of the future energy market (in terms of optimization, integrated planning, switching to the use of new substances, balancing the interests of infrastructure operators and various gas producers, etc.).

In addition, existing policies and measures create positive incentives for the development of natural gas production, however, according to market participants, they may not be sufficient to achieve the planned production volumes, let alone obtain additional volumes of gas for export.

The simulation results of the WEM scenario, based on the TIMES-Ukraine model, show that natural gas production in Ukraine may grow, but at a slow pace, which is estimated at 21-22 billion m³ in 2025-2030 and up to 24 billion m³ in 2050. At the same time, by 2025, the need for gas imports will be minimal, amounting to 8% in 2030 and almost 24% in 2050 (figure below).

Figure. 4.40. Production and import of natural gas in 2020-2050, bcm



4.6. Dimension Research, innovation and competitiveness

i. Current situation of the low-carbon-technologies sector and, to the extent possible, its position on the global market (that analysis is to be carried out at regional or global level)

International innovation ratings are one of the quality sources of information about the level of innovation in the country. This applies, in particular, to innovations in the field of energy and climate technologies.

European Innovation Scorecard

According to the European Innovation Scorecard (EIS) 2023⁴⁶⁶, Ukraine belongs to the "Emerging Innovators" group together with Bulgaria, Latvia, Poland, Romania, Slovakia and Croatia and demonstrates an efficiency indicator in innovation spheres of 31% of the European average of the Union. The EIS calls the export of intellectual services, environmentally friendly technologies, employment in service industries, venture investments and innovations without a significant R&D component as relatively strong points of the Ukrainian economy. On the other hand, the EIS considers product innovation, design, sales of innovative products, involvement in international scientific publications, and R&D expenditures in budget-financed sectors to be relatively weak sides of the Ukrainian economy.

Global Innovation Index

According to the Global Innovation Index 2023⁴⁶⁷, which is compiled annually by the World Intellectual Property Organization (WIPO), Ukraine ranked 55th among all analyzed countries and entered the top three most innovative countries in the lower-middle income group, along with India and Vietnam. According to the authors of the Global Innovation Index, the results of innovation sectors in Ukraine exceed the amount of investment in them (Output rank – 47 / Input rank – 78), which places Ukraine in the “innovation outperformer” group.

Clean Energy Demonstration Projects Database (IEA)

Some relevant international ratings and databases do not contain data on Ukraine or innovative energy and climate projects implemented in Ukraine. For example, one of the most famous databases of innovative energy projects - the International Energy Agency's Clean Energy Demonstration Database does not contain any mention of clean energy demonstration projects in Ukraine. At the same time, this database contains information about demonstration projects implemented in countries that are on the same level of innovation with Ukraine (according to the Global Innovation Index 2023) - for example, Vietnam and India.

The absence of innovative energy projects from Ukraine in this particular database may be due to the fact that our country became an associate member of the IEA quite recently (in 2021), as well as the fact that demonstration projects in the field of clean energy in Ukraine are financed and implemented, mostly by private companies without the participation of the state.

Funding of research and innovation within the framework of international agreements

A significant part of the research and innovation activity in Ukraine in the areas related to the National Energy and Climate Plan is carried out within the framework of the relevant agreements between Ukraine and the EU.

The legal basis for this interaction and for bilateral cooperation and dialogue in the field of research and innovation is the Agreement on scientific and technological cooperation between Ukraine and the European Union⁴⁶⁸, extended in 2022, as well as the Agreement between Ukraine, on the one hand, and the European Union and the European Atomic Energy Community, on the other hand, on Ukraine's participation in Horizon Europe and Euratom Research and Training Programme (2021-2025), complementary to Horizon Europe⁴⁶⁹. According to the terms of these agreements, Ukrainian

⁴⁶⁶ "European innovation scoreboard 2023." 06 July 2023,
https://research-and-innovation.ec.europa.eu/knowledge-publications-tools-and-data/publications/all-publications/european-innovation-scoreboard-2023_en.

⁴⁶⁷ "Global Innovation Index 2023: Innovation in the face of uncertainty - WIPO."
https://www.wipo.int/global_innovation_index/en/2023/.

⁴⁶⁸ https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv%3AOJ.L_.2022.095.01.0001.01.ENG&toc=OJ%3AL%3A2022%3A095%3ATOC

⁴⁶⁹ https://zakon.rada.gov.ua/laws/show/984_005-21#n2

players of the research and innovation sector can participate in them on equal terms with representatives of EU member states.

The European Union's framework program for research and innovation, Horizon Europe, has a total research grant budget of €95.5 billion for 2021-2027. A significant part of the funding is aimed at research in the field of solving climate and energy problems, in particular:

1. **Cluster 5 Climate, Energy and Mobility:** This cluster is dedicated to combating climate change, developing sustainable energy solutions and promoting mobility, covering a variety of programs and funding opportunities for sectors such as clean energy, renewable energy, energy efficiency, climate adaptation and others.
2. **European Green Deal Call:** a funding program for projects that contribute to achieving the goals of the European Green Deal towards climate neutrality by 2050.
3. **Mission Area on Climate-Neutral and Smart Cities:** areas of activity aimed at combating societal challenges, including achieving the goals of climate neutrality and "smart" cities. The task of this direction is to support research and innovation projects that contribute to the sustainable development of European cities.

In October 2023, the structural division "Horizon Europe Office in Ukraine" started working in Ukraine on the basis of the National Research Fund of Ukraine⁴⁷⁰.

Also, within the framework of the above-mentioned agreement, Ukraine received access to research and innovation programs covering energy and climate topics:

- EIC4Ukraine⁴⁷¹ is a program of financial and consulting support for Ukrainian deep-tech startups with a total budget of 20 million EUR.
- EU Mission for Climate Neutral and Smart Cities: a program with a budget of 5 million EUR, aimed at supporting partnerships with Ukrainian cities to support their efforts to rebuild with the principles of climate neutrality in mind
- Technologies for extraction and processing of critical raw materials (IA) is an initiative to support the construction of sustainable supply chains for critical materials, strengthening the EU's partnership with countries rich in relevant minerals to ensure the safety of industrial sectors and environmentally friendly transformation of extractive industries in partner countries.
- Excellence Hubs Initiative⁴⁷² is a "mentorship" program for the development of innovative components, to which Ukrainian participants are invited.

Several research projects in the fields of energy have already been implemented within the framework of the European Union Framework Program for Research and Innovation "Horizon Europe":

- BIOMETHAVERSE⁴⁷³: two Ukrainian organizations, Eco Energy and the Bioenergy Association of Ukraine, participate in this strategic project with a budget of 12 million euros, aimed at the development of technologies for the production of biomethane and green hydrogen in Europe according to the plans for the development of strategic energy technologies (SET plan).

⁴⁷⁰ The Office of the "Horizon Europe" program in Ukraine on the basis of NFSU has started its work <https://nrfu.org.ua/news/rozpochav-svoyu-robotu-ofis-programy-goryzont-yevropa-v-ukrayini-na-bazi-nfdu/>

⁴⁷¹ https://ec.europa.eu/commission/presscorner/detail/en/IP_22_3533

⁴⁷² https://rea.ec.europa.eu/funding-and-grants/horizon-europe-widening-participation-and-spreading-excellence/excellence-hubs_en

⁴⁷³ <https://cordis.europa.eu/project/id/101084200>

- TWISMA⁴⁷⁴ project is aimed at increasing the level of scientific development and innovation capacity of the Institute of Scintillation Materials (Kharkiv) and its partner institutions within the framework of Twinning programs for the development of innovative calorimeters based on advanced scintillation materials for use in the field of high-energy physics.

Other ratings and data sources

According to the World Bank, the share of gross added value of high- and medium-tech sectors in the total volume of gross added value of the manufacturing industry in 2015 was 63% in Switzerland, 50.5% in the Czech Republic, 61.4% in Germany, 42.8% in Israel, 63.7% in South Korea, 30.4% in Ukraine. At the same time, according to the State Statistics Service, this share in Ukraine in 2016 was 25.7% (7.6% and 18.1% in the high- and medium-tech sectors, respectively). If we compare the gross domestic product per capita in 2016 at current 2010 prices of the named states with the GDP per capita of Ukraine, according to the US National Science Foundation, this ratio will be from 8.5 times to 36 times.

According to the World Economic Forum in the 2020 Global Competitiveness Report, Ukraine ranked 94th among the 142 countries studied⁴⁷⁵.

According to the index of innovative development presented by the Bloomberg agency in 2020, Ukraine took 56th place among 60 studied states⁴⁷⁶.

⁴⁷⁴ <https://cordis.europa.eu/project/id/101078960>

⁴⁷⁵ "Global Competitiveness Report 2020 | World Economic Forum." 16 December 2020, <https://www.weforum.org/publications/the-global-competitiveness-report-2020/competitiveness-rankings/>

⁴⁷⁶ <https://www.bloomberg.com/news/articles/2020-01-18/germany-breaks-korea-s-six-year-streak-as-most-innovative-nation>

2020 Bloomberg Innovation Index

2020 Rank	2019 Rank	YoY Change	Economy	Total Score	R&D Intensity	Manufacturing Value-added	Productivity	High-tech Density	Tertiary Efficiency	Researcher Concentration	Patent Activity
1	2	+1	Germany	88.21	8	4	18	3	26	11	3
2	1	-1	S. Korea	88.16	2	3	29	4	16	5	11
3	6	+3	Singapore	87.01	12	2	4	17	1	13	5
4	4	0	Switzerland	85.67	3	6	14	10	17	3	19
5	7	+2	Sweden	85.50	4	16	19	7	13	7	18
6	5	-1	Israel	85.03	1	31	15	5	32	2	7
7	3	-4	Finland	84.00	10	15	9	14	24	9	10
8	11	+3	Denmark	83.22	7	24	6	8	31	1	24
9	8	-1	U.S.	83.17	9	27	12	1	47	29	1
10	10	0	France	82.75	13	39	16	2	20	17	8
11	12	+1	Austria	82.40	6	11	13	19	12	8	16
12	9	-3	Japan	82.31	5	5	35	9	30	16	12
13	15	+2	Netherlands	81.28	17	28	17	6	36	12	14
14	13	-1	Belgium	79.93	11	25	11	13	49	14	13
15	16	+1	China	78.80	15	14	47	11	5	39	2
16	14	-2	Ireland	78.65	34	1	1	12	39	20	34
17	17	0	Norway	76.93	16	51	5	20	10	10	22
18	18	0	U.K.	76.03	21	44	27	15	6	19	21
19	21	+2	Italy	75.76	24	23	21	16	33	25	20
20	19	-1	Australia	74.13	18	55	8	21	15	31	6
21	31	+10	Slovenia	73.93	19	8	20	40	14	15	26
22	20	-2	Canada	73.11	22	35	26	26	35	21	9
23	23	0	Iceland	71.56	14	36	3	-	3	4	27
24	25	+1	Czech Rep.	70.00	20	7	25	42	38	18	31
25	22	-3	Poland	69.98	35	17	39	22	19	38	29
26	27	+1	Russia	68.63	33	37	43	30	25	23	25
27	26	-1	Malaysia	68.28	23	9	46	25	41	40	38
28	32	+4	Hungary	68.24	25	13	40	18	54	30	48
29	24	-5	New Zealand	68.08	30	42	33	28	46	22	23
30	35	+5	Greece	66.30	32	50	43	27	9	28	40
31	28	-3	Luxembourg	65.41	29	45	10	48	59	6	4
32	29	-3	Romania	65.25	56	19	32	23	27	47	30
33	30	-3	Spain	65.11	31	30	34	44	18	26	35
34	34	0	Portugal	65.08	26	34	42	43	4	24	47
35	33	-2	Turkey	63.84	37	20	49	38	28	44	17
36	36	0	Estonia	62.79	27	29	22	-	23	27	41
37	42	+5	Latvia	62.03	54	47	24	24	21	42	45
38	37	-1	Lithuania	61.97	38	21	28	-	2	33	53
39	38	-1	Hong Kong	61.70	43	59	7	31	37	32	15
40	40	0	Thailand	60.36	44	18	51	33	29	48	33
41	39	-2	Slovakia	59.36	39	10	38	51	53	35	46
42	41	-1	Bulgaria	56.59	45	33	48	47	44	37	50
43	44	+1	Croatia	55.00	40	40	37	49	42	41	56
44	46	+2	U.A.E.	54.31	36	32	30	50	50	57	49
45	50	+5	Argentina	53.78	52	43	50	45	11	45	55
46	45	-1	Brazil	53.65	28	56	54	32	51	50	43
47	43	-4	Malta	53.48	50	46	23	36	45	36	60
48	48	0	Cyprus	51.56	49	58	36	34	56	46	51
49	NR	-	Algeria	51.24	51	12	55	55	7	54	59
50	51	+1	S. Africa	51.15	41	53	53	39	57	58	28
51	58	+7	Chile	49.58	58	49	41	56	22	53	39
52	52	0	Tunisia	49.56	48	48	56	41	52	43	54
53	56	+3	Saudi Arabia	49.54	42	22	45	52	43	-	37
54	54	0	India	49.33	46	54	59	29	55	59	32
55	57	+2	Qatar	48.81	55	26	31	-	58	52	58
56	53	-3	Ukraine	48.24	57	57	57	35	48	49	36
57	60	+3	Vietnam	47.64	53	52	60	37	40	55	42
58	NR	-	Egypt	46.29	47	38	58	46	60	51	52
59	NR	-	Kazakhstan	46.10	60	41	52	53	8	56	44
60	NR	-	Macao	46.09	59	60	2	54	34	34	57

Sources: Bloomberg, International Labor Organization, International Monetary Fund, World Bank, Organisation for Economic Cooperation and Development, World Intellectual Property Organization, United Nations Educational, Scientific and Cultural Organization

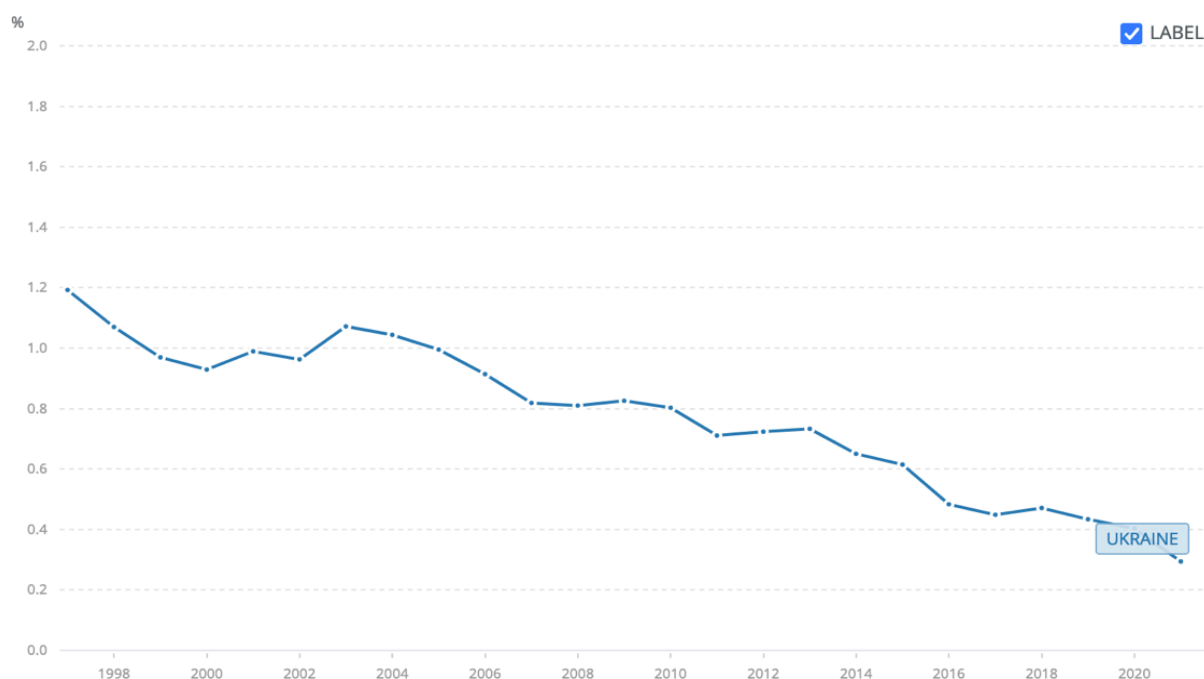
Notes: 1. **R&D intensity**: Research and development expenditure, as % GDP 2. **Manufacturing value-added**: MVA, as % GDP and per capita (PPP) 3. **Productivity**: GDP and GNI per employed person age 15+ and 3Y improvement 4. **High-tech density**: Number of domestically domiciled high-tech public companies -- such as: aerospace and defense, biotechnology, hardware, software, semiconductors, Internet software and services, and renewable energy companies -- as % domestic publicly listed companies and as a share of world's total public high-tech companies 5. **Tertiary efficiency**: Total enrollment in tertiary education, regardless of age, as % the post-secondary cohort; gross graduation ratio of first-degree earners, share of labor force with advanced level of education; annual new science and engineering graduates as % total tertiary graduates and as % the labor force 6. **Researcher concentration**: Professionals, including postgraduate PhD students, engaged in R&D per population 7. **Patent activity**: Annual patent filings, patent grants and patent-in-force, per population and/or GDP; 3Y avg growth of filings abroad and filings growth, per world total growth

All metrics are equally weighted. Metrics consisting of multiple factors were rescaled for countries void of some but not all data points. Most recent data available used. Of the more than 200 economies evaluated, 105 had data available for at least six of the seven factors and were ranked; The top 60 and the metric ranks among them are displayed.

ii. Current level of public and, where available, private research and innovation spending on low-carbon-technologies, current number of patents, and current number of researcher

Ukraine demonstrates quite low indicators of spending on research and innovation compared to other Eastern European countries. Thus, according to the World Bank⁴⁷⁷, as of 2021, expenditures on R&D in Ukraine amounted to only 0.29% of GDP.

Figure 4.41. Ukraine's expenditures on R&D as a percentage of GDP



⁴⁷⁷ <https://data.worldbank.org/indicator/GB.XPD.RSDV.GD.ZS?contextual=region&end=2021&locations=UA&start=1997&view=chart>

Spending on research in the sector of low-carbon technologies and innovations in Ukraine is carried out by both public and private structures.

State institutions finance development in the field of research and innovation mainly through specialized research institutions and grant funding from the National Research Fund. Key research institutions include:

1. State

- Institute of Renewable Energy of the National Academy of Sciences of Ukraine
- Institute of Technical Thermophysics of the National Academy of Sciences of Ukraine
- Institute of Bioenergy Crops and Sugar Beet (National Academy of Agrarian Sciences)
- Institute of Electrodynamics of the National Academy of Sciences of Ukraine
- Department of Hydrogen Energy of the Institute of Mechanical Engineering Problems named after A.M. Pidgorny National Academy of Sciences of Ukraine
- Hydrogen Technology Center of the Gas Institute of the National Academy of Sciences of Ukraine
- Ivano-Frankivsk National Technical University of Oil and Gas

2. Private

- "Biomass Scientific and Technical Center" LLC (approximately 15 researchers)
- MHP "Eco Energy" (approximately 20 researchers)

2. Separate departments of universities

- Educational and Scientific Institute of Energy, Automation and Energy Saving (NUBIP)
- Department of renewable energy sources of NTU KPI
- Department of RES engineering at IFNTUNG

It is worth mentioning that there is a bachelor's degree specialty "Renewable energy sources and hydropower" in the educational field "Electrical engineering" ⁴⁷⁸. This specialty is taught at the following ⁴⁷⁹ universities:

- NUVHP (Rivne)
- Vinnytsia National Technical University
- NTU "KhPI"
- KNUBA
- Lviv National University of Nature Management
- ZNU (Zaporizhia)

The assessment of specific volumes of **private companies' investments** in research and innovation in the field of low-carbon technologies in Ukraine is complicated by the non-publicity of a significant number of investments made by private companies. The latter can be divided into several groups with different business models and sources of capital.

⁴⁷⁸ <https://osvita.ua/consultations/spec-bach/64447/>

⁴⁷⁹ <https://osvita.ua/consultations/vartist-navchannya/90604/>

Startups

These low-carbon innovation market players in Ukraine are focused on working in global markets, mostly ignoring the Ukrainian market as too small in scale for their developments. The main sources of funding for Ukrainian climate startups are:

- Angel/venture capital
- Equity (bootstrapping)
- Grant funding

Clearly evaluating investments in low-carbon technologies of Ukrainian startups is a difficult task due to the non-publicity of these investments and the own contribution of companies and their founders, which is often not expressed in financial terms.

Corporate innovations

The corporate sector in Ukraine relies more on technologies that are much closer to the commercialization stage than those developed by startups, or are already commercially available globally, but are still very new to the Ukrainian market. The biggest corporate innovators in Ukraine include:

- DTEK - invests in storage technologies, smart networks, electromobility, has its own research centers and an innovation program. DTEK became the first company to implement an energy storage system with a capacity of 1 MW at the currently occupied Zaporizhzhya TPP;
- MHP - invests in biomass processing technologies, hydrogen technologies, energy storage, electric mobility, has its own research centers;
- KNESS - invests in research and development of "smart grid" technologies and energy storage systems. It was the first to receive a license for the commercial use of energy storage systems;
- RGC (now the main assets under the management of the Naftogaz Group) - carried out a study of the possibility of transporting renewable gases (hydrogen and biomethane) through a distribution network built for natural gas;
- GALS Agro, VitAgro - invest in biomass processing technologies into renewable gas (biomethane), interested in Biomethane2grid projects;
- Aventston;
- Atmosfera.

It should be noted that today a significant number of Ukrainian companies have started investing in the use of low-carbon technologies, primarily energy technologies. The following factors became the drivers of such investments:

- The business need to ensure its own energy security and reduce costs. After the shelling of the energy infrastructure by the Russian troops, the problem of providing themselves with energy became acute for many businesses. Therefore, Ukrainian entrepreneurs began to install means of generation and storage of electricity "behind the meter";
- Exporters' efforts to minimize the financial impact of CBAM implementation on them. Ukrainian companies exporting their goods to EU countries calculate the financial consequences of CBAM implementation and invest in low-carbon production chains.

Table 4.15. The number of patents in subsectors of the green economy in Ukraine⁴⁸⁰

	СРС (Спільна патентна класифікація)	Кількість патентів (ранній пріоритет => 2010)
Вітрова енергетика	Y02E10/70-766	270
Сонячна енергетика	Y02E10/40-47	153
Гідроенергетика	Y02E10/20-28	112
Фотовольтаїка	Y02E10/50-58	52
Паливо з відходів	Y02E50/30-346	50
Сільське господарство	Y02P60	42
Ядерна енергетика	Y02E30	32
Морська енергетика	Y02E10/30-38	30
Переробка біоорганічної фракції	y02w30/40-47	13
Біопаливо	Y02E50/10-18	12
Воднева енергетика	Y02E70 Y02E60/30+	5
Гібридні сонячні технології	Y02E10/60	5
Надпровідникові електричні елементи	Y02E40/60-69	0
Геотермальна енергетика	Y02E10/10-18	0

iii. Breakdown of current price elements that make up the main three price components (energy, network, taxes/levies)

The market price for electricity for end consumers consists of component prices/tariffs determined by the Law of Ukraine "On the Electricity Market". The preferential level of the fixed price for the population is provided due to the mechanism of imposing special obligations (PSO) on state electricity producers. Yes, the difference between the market and fixed electricity prices is financed by the revenues of Energoatom JSC and PrJSC Ukrhydroenergo.

Key price components for Ukrainian consumers:

- The cost of electricity on the wholesale electricity market (variable, depending on the segment and terms of purchase);
- Tariff for electricity transmission services for system users (except for enterprises of green electrometallurgy) - UAH 528.57/MWh (without VAT)⁴⁸¹ ;
- Average weighted tariff for services for the distribution of electricity through low-voltage networks – UAH 1,619.94/MWh (without VAT)⁴⁸² ;

⁴⁸⁰ I. Yu. Yehorov, doctor of economics. of Sciences, professor, member-cor. NAS of Ukraine V. Yu. HRYGA, candidate economy sciences, p. N. with. Yu. O. RYZHKOVA, b. p. "PATENTING ACTIVITY IN THE SPHERE OF THE GREEN ECONOMY: CURRENT STATE AND PROBLEMS" SCIENCE, TECHNOLOGY, INNOVATIONS • 2021, No. 3 http://nti.ukrintei.ua/wp-content/uploads/2022/11/%D0%84%D0%B3%D0%BE%D1%80%D0%BE%D0%B2_3-2021-1.pdf.

⁴⁸¹ Resolution of the NEURC of December 9, 2023 No. 2322 "On setting the tariff for electricity transmission services of NEC Ukrrenergo for 2024"

⁴⁸² Resolutions of the NEURC of December 9, 2023 No. 2324-2355 regarding the establishment of tariffs for 32 public utility companies that carry out economic activity in the distribution of electricity with the application of stimulating regulation and according to the "costs +" methodology

- Tariff for the supplier's services (contractual or fixed - for consumers of suppliers at free prices, fixed - for consumers of universal service suppliers and the supplier of last resort);
- Taxes (VAT, excise).

iv. Description of energy subsidies, including for fossil fuels

In Ukraine, there are several types of direct and indirect subsidies on state-regulated energy markets (gas, electricity, district heating). The system of energy subsidies in Ukraine is primarily aimed at protecting vulnerable households that can be characterized as energy poor. However, the biggest beneficiaries of this system are wealthy citizens. This is a result of the fact that the system of energy subsidies in the mentioned markets consists of several levels:

1. Different tariffs for households and legal entities. In the gas, district heating and electricity markets, there are preferential prices/tariffs for households (domestic consumers) and market prices for legal entities. Separate preferential prices/tariffs also exist for religious organizations;
2. Targeted Subsidies for Vulnerable Consumers allow financial assistance to be provided to households whose utility costs exceed a percentage of their monthly income set by the Government.

Typical mechanisms that allow setting prices/tariffs for domestic consumers (households) at a level lower than economically reasonable are as follows:

- Cross-subsidization at the expense of the income of electricity producers, determined by the Cabinet of Ministers of Ukraine within the framework of the mechanism of imposing special duties on individual market participants to ensure public interest (PSO) - for example, in the electricity market;
- Reimbursement through co-financing of state-owned companies involved in PSO from the state budget (for example, on the gas market);
- Support for heat producers from local budgets.

Terminological remarks

It is worth noting that there are several interpretations of subsidies in the legal framework of Ukraine, in particular, a number of different terms are used in relation to budget policy and state support. These terms can be compared to components of the broader definitions used by international organizations.

A direct and rather narrow definition of subsidies is given in the Instruction on the application of the economic classification of budget expenditures ⁴⁸³, approved by order of the Ministry of Finance No.333 of March 12, 2012. According to the instruction, subsidies are defined as "all gratuitous current payments to enterprises that do not provide for compensation in the form of specially stipulated payments or goods and services in exchange for payments made, as well as expenses related to compensation for losses of state

⁴⁸³ Instructions on the application of economic classification of budget expenditures
<https://zakon.rada.gov.ua/go/z0456-12>

enterprises". The budget legislation of Ukraine contains the concepts of subventions, subsidies and other transfers, which can be considered subsidies according to international definitions.

The Law of Ukraine "On State Aid to Business Entities"⁴⁸⁴ defines that state aid is support in any form to economic entities at the expense of state or local resources, which distorts or threatens to distort economic competition, creating advantages for production certain types of goods or the conduct of certain types of economic activity. This law also defines that state aid consists in the transfer of state or local resources to individual economic entities, as well as in the loss of revenues of the relevant budgets. The forms of state aid include, in particular: the provision of subsidies and grants, the provision of subsidies, the provision of tax benefits, the postponement or deferment of the payment of taxes, fees or other mandatory payments.

Also, since May 16, 2008, Ukraine is a member of the World Trade Organization (WTO), therefore the definition "subsidy" given in the Agreement on Subsidies and Compensatory Measures (SCC Agreement)⁴⁸⁵ is automatically applied to state regulation in Ukraine.

1.1 For the purposes of this Agreement, it is considered that a subsidy is:

a) 1) a financial contribution provided in the territory of a WTO member by the government or any state body (in this agreement the government is referred to), i.e. when:

i) the government practices direct transfers of funds (such as grants, loans or capital injections), potential direct transfers of funds or obligations (such as loan guarantees);

ii) the government forgoes or fails to collect revenues that belong to it (for example, such fiscal stimulus measures as tax credits)[1];

iii) the government provides goods and services, other than general infrastructure, or procures goods or services;

iv) the government makes payments to the financing mechanism or entrusts or directs a private institution to perform one or more of the functions specified in points "i" and "iii" above that would normally be performed by the government, and the practice of their application by such an institution does not differ in fact from practices that would normally be conducted by the government;

or

a) 2) income or price support in any form within the meaning of Article XVI [GATT 1994](#); and

b) the benefit thus provided.

Subsidy in accordance with the definitions of paragraph 1 falls under the provisions of Part [II](#) or [Part III](#) or [V](#) only if such subsidy is targeted in accordance with the provisions of Article 2.

Subsidies on the gas market

Subsidies on the natural gas market are received by all households (domestic consumers) regardless of their income level, in accordance with the Law of Ukraine "On the Peculiarities of Regulation of Relations in the Natural Gas Market and in the Field of Heat Supply During Martial Law and the Subsequent Restoration of Their Functioning."

In addition, the PSO mechanism operates on the natural gas market. For more information on the level of prices and other consumers covered by PSO, see in section 4.5.3.i.

⁴⁸⁴ <https://zakon.rada.gov.ua/laws/show/1555-18#Text>

⁴⁸⁵ Agreement on subsidies and compensatory measures https://zakon.rada.gov.ua/go/981_015_.

The specified acts define mechanisms for ensuring subsidized prices for gas used by households (household consumers):

- directly (in the form of gas physically delivered to households);
- through DHCs that generate heat and hot water for the needs of domestic consumers.

According to the Law of Ukraine "On the Natural Gas Market", the market entity, which is entrusted with special duties, has the right to receive compensation for economically justified costs (minus the income received in the process of implementing the PSO), taking into account the permissible level of profit. The calculation of such compensation takes place in accordance with the procedure approved by the resolution of the Cabinet of Ministers of Ukraine of December 3, 2020 No. 1194⁴⁸⁶.

The field of centralized heat supply

Centralized supply of thermal energy is also characterized by the presence of subsidized tariffs for heat and hot water supply for domestic consumers. This subsidy is implemented through a combination of subsidized gas prices for DHCs and support of DHCs from local budgets.

This system was formed as a result of a combination of two factors:

- Implementation of the PSO mechanism on the gas market, which ensured regulated prices for gas supplied by LLC GSC Naftogaz Trading to DHCs for various needs;
- Transfer of powers to calculate and approve tariffs for heat and hot water supply from NEURC to local government.

Tariffs for heat and hot water supply for the population in different cities differ significantly due to the economic parameters of DHCs and the level of their budgetary support from local budgets.

Thus, in the field of centralized heat supply, there is a dual system of subsidies - at the state and local levels. Heat tariffs approved by local councils often do not meet the requirements of the Law of Ukraine "On Heat Supply", which requires that the tariffs be no less than the cost price. At the same time, during the period of martial law in Ukraine and 6 months after its termination, the Law of Ukraine No. 2479-IX of 07.29.2022 (as amended) prohibits the increase of tariffs for natural gas distribution services for all categories of consumers and for thermal energy (its production, transportation and supply), services for the supply of thermal energy and supply of hot water - for the population⁴⁸⁷.

It should be noted separately that subsidizing the gas tariff has a negative effect on the production of heat from renewable energy sources, in particular - from biomass. According to the legislation, there is a simplified mechanism for approving tariffs for a gigacalorie of heat produced from biomass at the level of 90% of the cost of a gigacalorie produced from gas. Since the state subsidizes the price of natural gas within the framework of PSO, the production of thermal energy from biomass for the needs of the population has no economic meaning, and this leads to the following consequences:

⁴⁸⁶ <https://zakon.rada.gov.ua/laws/show/1194-2020-%D0%BF#n10>

⁴⁸⁷ <https://zakon.rada.gov.ua/laws/show/2479-20#Text>

- Investors refuse to finance projects involving the use of biomass for the supply of heat energy for the population. Instead, they invest in projects involving the supply of heat to legal entities;
- DHCs that use biomass to generate heat stop their work or their work is subsidized from local budgets.

At the same time, in the conditions of martial law, it is important to ensure the implementation of measures for the development of decentralized heat supply systems (modular boiler houses, cogeneration plants, etc.).

Subsidies in the electricity market

The key normative acts that determine the mechanisms of subsidizing in the electricity market are the Resolution of the Cabinet of Ministers of Ukraine of June 5, 2019 No. 483 "On Approval of the Regulation on Imposition of Special Duties on Participants of the Electricity Market to Ensure Public Interests in the Process of Functioning of the Electricity Market (Official Gazette of Ukraine, 2019, No. 49, Article 1658; 2021, No. 67, Article 4232; 2022, No. 87, Article 5385; 2024, No. 11, Article 671; 2024, No. 43, Article 2604)⁴⁸⁸ and the Law of Ukraine "On the Electricity Market" (Official Gazette of Ukraine, 2019, No. 49, Article 1658; 2021, No. 67, Article 4232; 2022, No. 5385; 2024, No. 671; 2024, No. 489). See also PM_IM_WEM_03 Regulation and liberalization of retail prices.

Among the mechanisms of subsidizing prices, which are implemented through the PSO mechanism and/or involve the redistribution of funds in the market:

- Price subsidies for households;
- Subsidizing the production of electricity from RES through the fee-in tariff.

The State Enterprise "Guaranteed Buyer", created in June 2019 to implement the Resolution of the Cabinet of Ministers of Ukraine of April 17, 2019 No. 324 "On the formation of state-owned enterprises "Guaranteed Buyer" and "Market Operator" (Official Gazette of Ukraine, 2019 p., No. 34, Article 1206) to perform the functions of a guaranteed buyer of electricity from renewable sources.

In order to ensure the supply of electricity to the population at lower than market prices, JSC NAEK Energoatom and PrJSC Ukrhydroenergo compensate the losses incurred by universal service providers (UPS) in the supply of electricity to the population. Taking into account the significant costs of state-owned generating companies (only for 2023, JSC NAEK Energoatom estimated the costs of implementing PSO at UAH 128 billion⁴⁹⁰, Ukrhydroenergo - at UAH 23.67 billion⁴⁹¹), these duties make it impossible to direct investment resources for development programs, for example, the accumulation of resources for the future decommissioning of NPP power units.

Transformation of subsidies in the energy sector

Since the publication of the first comprehensive analysis of fossil fuel subsidies in Ukraine (OECD,

⁴⁸⁸ Decree of June 5, 2019 No. 483 "On the approval of the Regulation on imposing special obligations on participants of the electricity market to ensure the interests of the general public in the process of functioning of the electricity market" (Official Gazette of Ukraine, 2019, No. 49, Art. 1658, No. 67, No. 5385, No. 2024, No. 2604 zakon.rada.gov.ua/go/483-2019-%D0%BF).

⁴⁸⁹ Law of Ukraine "On the electricity Market." <https://zakon.rada.gov.ua/go/2019-19>.

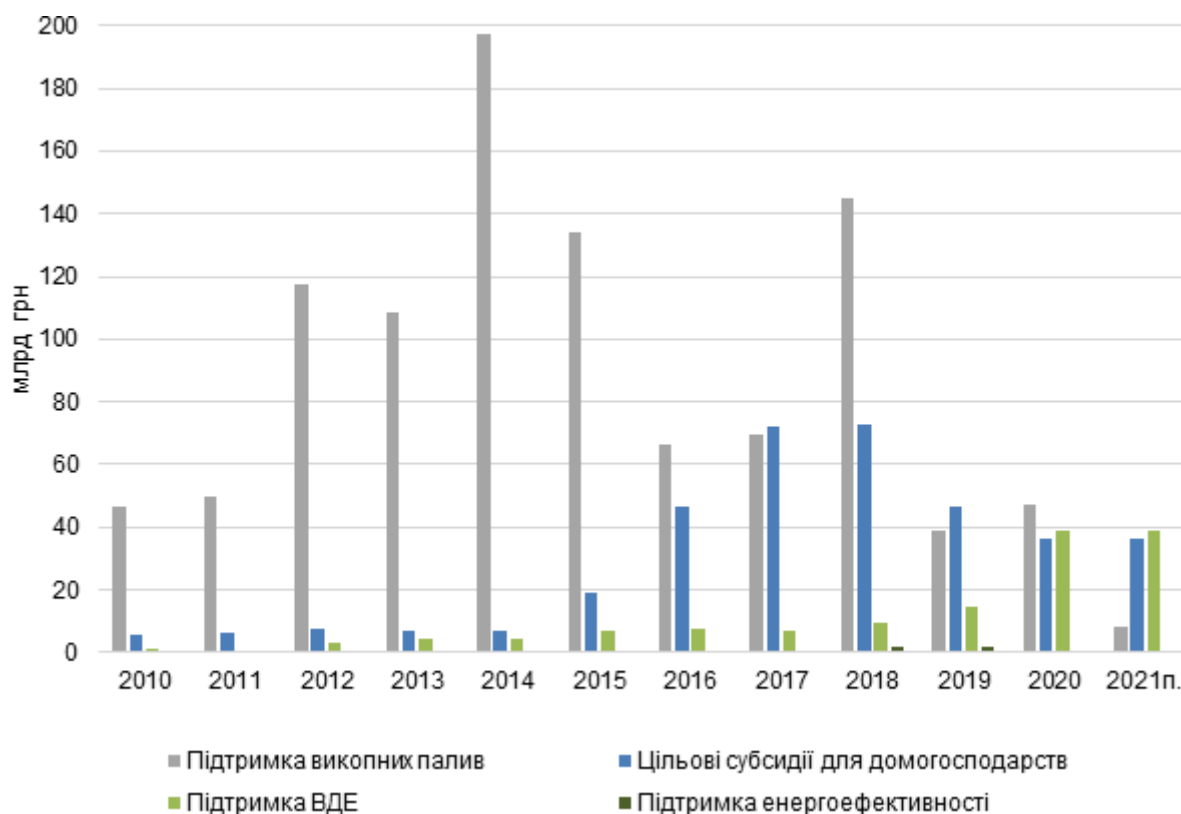
⁴⁹⁰ <https://www.energoatom.com.ua/o-1201241.html>

⁴⁹¹

https://uhe.gov.ua/media_tsentr/novyny/ihor-syrota-ukrhydroenerho-povnistyu-vykonalo-zobov'yazannya-z-psyo-za-2023-rik

2018) the landscape of energy subsidies has changed significantly. The graph below illustrates the development of public support for fossil fuel production and consumption, targeted subsidies to households, support for renewable energy sources and energy efficiency.

Figure. 4.42. State aid in energy



Most of the energy used to produce energy for household consumption also falls into the "fossil" category. However, targeted subsidies for households are shown as a separate group, since this type of support is more effective and is considered an acceptable form of social assistance for low-income households.

During 2014-2021, there was a clear trend towards the removal of "blanket" fossil fuel subsidies, while the amount of targeted subsidies and household benefits was increased to ensure that the poor were supported during utility tariff increases. State support for fossil fuels reached a maximum of UAH 197 billion in 2014, although the level in 2018 was also very high (nearly UAH 145 billion), mainly due to cross-subsidies in the electricity sector and the need for domestic gas to sell it at regulated, lower than market, prices under the PSO regime⁴⁹².

In 2017 and 2019, the volume of targeted subsidies to households slightly increased the value of "total" fossil fuel subsidies. However, it should be noted that the estimates of subsidies for certain years should not be compared with each other, since in certain years the providers of communal services and

⁴⁹² Prepared on the basis of preliminary estimates of fossil fuel subsidies in the Eastern Partnership countries, published in the OECD report (2018), data of the Ministry of Finance (2020, 2018, 2017, 2014, 2013, 2010), NKRE (2014), NEURC (2021, 2020, 2019, 2018, 2017, 2015), of the State Treasury Service (2021).

NJSC Naftogaz of Ukraine received compensation for providing services at below-market prices for several years. For example, in 2020 Naftogaz received compensation for the difference between the price of imported natural gas and its sale for the production of heat for households for the period 2015-2019.

As the production of electricity from renewable energy sources is growing rapidly, the amount of support directed to RES has increased more than 11 times since 2012 to UAH 39 billion in 2020. At the same time, state support for energy efficiency remains minimal compared to subsidies in other sectors. In 2018 and 2019, about 1.9 billion and 1.8 billion UAH were allocated from the budget, respectively, to support the Energy Efficiency Fund and the Energy Efficiency Program "Warm Loans". Funding for these programs has been cut dramatically in subsequent years, in part due to the COVID-19 pandemic.

Table 4.16. State aid for fossil fuel production and consumption in Ukraine, UAH million⁴⁹³

Program	Support mechanism	Indicator ⁴⁹⁴	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021 p.
Restructuring of the coal and peat industry	direct transfer	SEP	-	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	3,269	4,525
Decommissioning unprofitable coal and peat mining enterprises	direct transfer	SEP	-	1,059	1 597	1,078	1 178	355	206	107	244	281	128	639
Rescue measures at coal mining enterprises	direct transfer	SEP	275	378.6	414	430	288	234	263	288	290	289	290	340
Prevention and elimination of emergency situations in coal mines	direct transfer	SEP	n.a.	1.1	n.a.	0.4	n.a.	n.a.	n.a.	10	82	n.a.	n.a.	n.a.
Liquidation of the emergency situation on the main gas pipeline "Luhansk - Lysychansk - Rubizhne"	direct transfer	SEP	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	35	n.a.	n.a.	n.a.	n.a.
Liquidation of the emergency situation at the Vuhlehirsk TPP	direct transfer	SEP	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Partial compensation of costs for the production of finished commercial coal	direct transfer	SEP	5,807	6,710	10 172	13,302	8,705	1 212	1 373	2 122	1 072	n.a.	n.a.	n.a.
Improvement of safety measures at coal mining enterprises	direct transfer	SEP	70	134	260	197	3	n.a.	n.a.	99	n.a.	n.a.	n.a.	n.a.
Construction and technical re-equipment of coal and peat mining enterprises	direct transfer	SEP	337	1 719	1 293	343	54	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Replenishment of working capital or increase of statutory funds of coal mines to repay arrears from wages	direct transfer	SEP	n.a.	n.a.	n.a.	n.a.	n.a.	200	500	n.a.	n.a.	n.a.	n.a.	n.a.
Repayment of debt for electricity of state-owned coal mining enterprises	direct transfer	SEP	140	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	445	n.a.	n.a.
State support for the construction of mine No. 10 "Novovolynska"	direct transfer	SEP	n.a.	n.a.	n.a.	n.a.	n.a.	146	50	70	35	62	n.a.	n.a.
Measures to support domestic coal production and reform the coal industry	direct transfer	SEP	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	1 671	n.a.	n.a.	n.a.
State support of PJSC "MGU"	direct transfer	SEP	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	0.13	20	n.a.	n.a.	n.a.
Compensation of NJSC "Naftogaz of Ukraine" for the difference between purchase prices for imported natural gas and its implementation for the production of heat for households	direct transfer	SEC	3 424	n.a.	3,900	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Transfer of the Smilacomunteploenergo budget to prevent an emergency situation in the city of Smila due to the company's financial inability to pay for natural gas	direct transfer	SEC	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	15	n.a.	n.a.
Subsidy from the state budget to local budgets to compensate for the difference between the actual costs of communal services and the established tariffs	direct transfer	SEC	n.a.	2,857	14,443	2,052	12,423	4,685	n.a.	1 798	978	n.a.	n.a.	n.a.
Subsidy from the state budget to local budgets	direct	SEC	5 131	6,069	6,718	6,046	6 173	17,995	44 120	69,740	69,977	21,561	n.a.	n.a.

⁴⁹³ Prepared on the basis of preliminary estimates of fossil fuel subsidies in the Eastern Partnership countries, published in the OECD report (2018), data of the Ministry of Finance (2020, 2018, 2017, 2014, 2013, 2010), NKRE (2014), NEURC (2021, 2020, 2019, 2018, 2017, 2015), of the State Treasury Service (2021).

⁴⁹⁴ SEP – support for energy producers, SEC – support for energy consumers

for the provision of benefits and housing subsidies for the payment of communal services to low-income households	transfer													
Subsidy from the state budget to local budgets for the provision of benefits and housing subsidies for the purchase of solid and liquid household stoves and liquefied gas for low-income households	direct transfer	SEC	496	557	738	733	715	1 121	2,280	2,633	2,694	1 820	n.a.	n.a.
Direct payments of benefits and housing subsidies to households for partial coverage of utilities, solid and liquid fuels and liquefied gas costs	direct transfer	SEC	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	23,267	36,357	35,208
Repayment of salary arrears to employees of Shakhta Nadiya PJSC	direct transfer	SEP	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	51	n.a.
Compensation of Naftogaz of Ukraine for the supply of imported gas to PSO consumers	direct transfer	SEC	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	32,205	n.a.
Ensuring the acquisition of "Operator GTS of Ukraine" LLC of JSC "MGU" from JSC "Ukrtransgaz"	direct transfer	SEP	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	3,851	n.a.
Compensation to consumers who use electric heating for the increase in electricity prices	direct transfer	SEC	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	1,400
Total direct transfers			16,739.1	20023.3	39016.7	24393.3	28716.0	25799.0	48,692.6	77 039.6	77 100.7	50,856.3	78 057.9	41 105.2
Deduction of corporate income tax for expenses of energy enterprises planned as part of investment programs	tax relief	SEP	n.a.	263	975	761	957	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Corporate income tax credit for the amount of excise tax levied on heavy distillates (gasoline) used in vehicles	tax relief	SEP	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	735	639	n.a.	n.a.
Deduction of corporate income tax for expenses related to the exploration and organization of oil and gas deposits	tax relief	SEP	-	23	-	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Temporary VAT relief for natural gas supply operations imported by NJSC "Naftogaz of Ukraine"	tax relief	SEP	n.z.	575	1 464	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Temporary relief from VAT for the supply of coal and/or its enrichment products in the customs territory of Ukraine	tax relief	SEP	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	2 116	2,609	3,042	2,808	1 333	1 431
Exemption from excise tax for sales of household goods at specialized auctions for household needs	tax relief	SEC	n.a.	13	69	78	78	14	14	109	65	57	n.z.	n.z.
Reduction of the excise tax rate for operations on the sale of aviation gasoline and fuel for jet engines produced in Ukraine, as well as imported	tax relief	SEC	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	5 191	2,235	2 398
Total tax benefits			-	873.9	2507.5	838.8	1035.6	14.1	2 129.8	2 717.5	3 841.4	8,694.7	3 568.4	3 828.9
Requirements for domestic gas producers (more than 50% owned by the state) regarding the sale of gas for household needs at regulated tariffs	indirect transfer	SEC	-	-	43 168	44,493	36,679	53,893	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Requirements for domestic gas producers to sell gas at regulated prices under the PSO regime	indirect transfer	SEC	n.a.	n.a.	n.a.	n.a.	n.a.	-	16404.7	25529.1	91092.7	n.a.	1683.45	n.a.
Cross-subsidization in the electric power industry	indirect	SEC	23,326	28,048	34,467	37,557	40,825	43,848	45,466	36,595	45,344	26,053	n.a.	n.a.
Total indirect transfers			23 326.4	28048.1	77634.6	82050.1	77503.3	97741.0	61 870.7	62 124.1	136 436.2	26 052.5	1 683.5	n.z.
Increasing the authorized capital of Naftogaz of Ukraine by means of the mechanism of issuing government bonds to cover its deficit	transfer of risk to the government	SEC	12,400	7,500	6,000	8,000	96,610	29,700	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Total risk transfer to government			12,400	7,500	6,000	8,000	96,610	29,700	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
In total, all support mechanisms			2 465.5	56445.4	125158.8	115282.3	203864.5	153254.2	112 693.1	141 881.2	217 378.8	85 603.5	83 309.7	44,934.0

Table 4.17. State aid for energy efficiency measures and electricity produced from renewable energy sources, million UAH ⁴⁹⁵

Program	Support mechanism	Indicator ⁴⁹⁶	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021 p.
Program of cheaper loans	direct transfer	SEC	n.a. ⁴⁹⁷	1	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Energy efficiency program	direct transfer	SEC	11	282	57	n.z.	2	302	861	818	418	546	384	150
Energy Efficiency Fund	direct transfer	SEC	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	1,500	1 219	n.a.	100
Total energy efficiency support			11	283	57	n.a.	2	302	861	818	1 918	1 765	384	250
Exemption from corporate income tax on the income of electricity producers who produce electricity exclusively from renewable energy sources	tax relief	SEP	-	-	468	450	-	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Exemption from corporate income tax in relation to the revenues of biofuel producers received from the sale of biofuel	tax relief	SEP	120	-	15	15	15	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Exemption from corporate income tax on revenues from combined heat and power plants using biofuels and heat energy using biofuels	tax relief	SEP	-	-	548	0	0	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Zero rate of excise tax on bioethanol used for the production of biofuel and bioethanol and gasoline fuel blends	tax relief	SEC	1 153	-	752	788	183	776	1 663	532	569	-	-	-
Exemption from VAT on materials, materials and equipment for the production of renewable energy sources, production of electricity from renewable sources, as well as equipment for energy maintenance, if the same goods are not produced in Ukraine	tax relief	SEP	-	-	-	-	-	-	-	-	-	-	-	-
Exemption from import duty on materials, materials and equipment for the production of renewable energy sources, production of electricity from renewable sources, as well as energy-saving equipment, if the same goods are not produced in Ukraine	tax relief	SEP	-	64	-	-	-	-	-	-	-	-	-	-
Total tax benefits			1 273	64	1 783	1 253	198	776	1 663	532	569	-	-	-
"Green" tariff for producers of electricity from renewable energy sources (wind, solar energy, biomass, small hydropower, etc.)	indirect transfer	SEP	119	271	700	3,029	4,322	5,973	5,946	6,624	9 136	14,915	39,033	-
Total support for renewable energy producers			1 392	336	3 484	4,282	4,520	6,748	7,610	7 156	9,706	14,915	39,033	-
Total energy efficiency and RES support			1 402	618	3,540	4,282	4,523	7,050	8 471	7,974	11,624	16,680	39,416	250

⁴⁹⁵ Prepared on the basis of preliminary estimates of fossil fuel subsidies in the Eastern Partnership countries, published in the OECD report (2018), data of the Ministry of Finance (2020, 2018, 2017, 2014, 2013, 2010), NERC (2014), NERCP (2021, 2020, 2019, 2018, 2017, 2015), of the State Treasury Service (2021).

⁴⁹⁶ SEP – support for energy producers, SEC – support for energy consumers

⁴⁹⁷ n.a.: not applicable, -: no data, p. – preliminary data.

5. IMPACT ASSESSMENT OF PLANNED POLICIES AND MEASURES

5.1. Impacts of planned policies and measures described in section 3 on energy system and GHG emissions and removals, including comparison to projections with existing policies and measures (as described in section 4).

i. Projections of the development of the energy system and GHG emissions and removals as well as the impact of the implementation of Directive 2001/80/EC as adapted and adopted by Ministerial Council Decision 2013/05/MC-EnC, amended by Decision 2015/07/MC-EnC and Directive 2010/75/EU as adapted and adopted by Ministerial Council Decision 2013/06/MC-EnC, amended by Decision 2015/06/MC-EnC, with particular regard to limited lifetime derogation

The table below shows the main modeling and forecasting results obtained using the TIMES-Ukraine model and other modeling tools regarding GHG emissions in Ukraine under the scenario with additional (planned) policies and measures (with additional measures, WAM).

Table 5.1. The main results of modeling in the field of GHG emissions in Ukraine according to WAM scenario⁴⁹⁸

Scenario with Additional Policies and Measures (WAM)									
	1990	2015	2020	2025	2030	2035	2040	2045	2050
The total amount of GHG emissions, million tons of CO₂-eq.	911	334	318						
Sectors of energy, industrial processes and product use	844	267	264	173	134	122	101	81	62
Agriculture	87	39	42	37	41	46	48	49	51
Land use, land use change and forestry*	-31	20	-0.4	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Waste sector	12	13	12	11	11	10	9	8	7
The share of GHG emissions from the level of 1990, %	100	37	35						
<i>Sectors of energy, industrial processes and product use</i>	100	32	31	22	19	16	15	12	9
<i>Agriculture</i>	100	45	48	42	47	50	52	54	55
<i>Land use, land use change and forestry and forestry</i>	100	265	199	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
<i>Waste sector</i>	100	45	48	42	47	50	52	54	55

Source: National Inventory of Anthropogenic Emissions from Sources and Absorption by Sinks of Greenhouse Gases in Ukraine for 1990-2021, Institute for Economics and Forecasting of the National Academy of Sciences of Ukraine.

Notes: *Currently, it is impossible to analyze the situation in the LULUCF sector and develop a reasonable forecast of GHG emissions in this sector due to the war and the related lack of reliable data on the LULUCF sector.

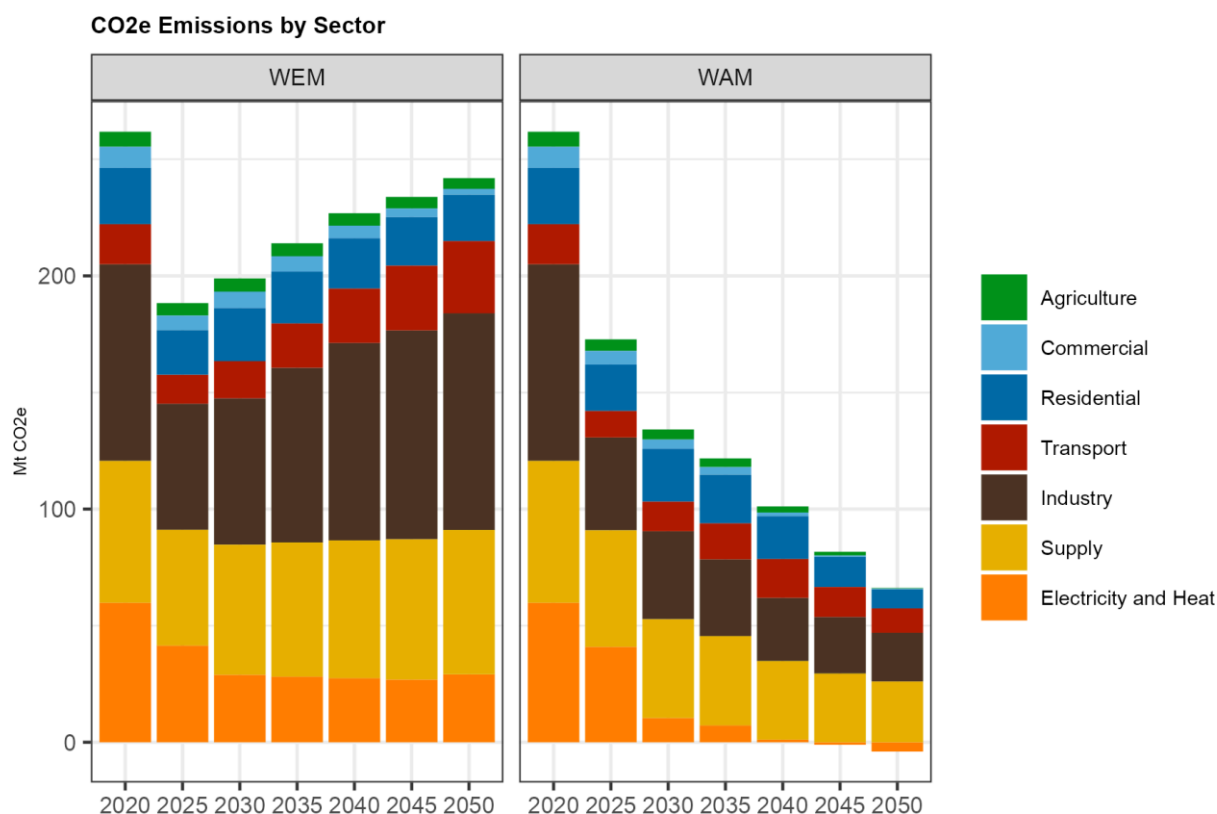
n.d. - no data.

⁴⁹⁸ Data for 1990-2020 from the State Statistics Service, National Inventory of Anthropogenic Emissions from Sources and Absorption by Sinks of Greenhouse Gases in Ukraine for 1990-2021.

Greenhouse gas emissions in the "Energy" and "Industrial processes and product use" sectors

The figure below shows the forecast of greenhouse gas emissions until 2050 in the sectors "Energy" and "Industrial processes and product use" (in the sense of the UN IPCC) with two scenarios WEM and WAM using the TIMES-Ukraine model.

Fig. 5.1 . Greenhouse gas emissions in the "Energy" and "Industrial processes and product use" sectors according to the WEM and WAM scenarios, million tons of CO₂-eq.



Source: calculations of the Institute of Economics and Forecasting of the National Academy of Sciences of Ukraine based on the TIMES-Ukraine model

The simulation results show that even rapid processes of recovery of the economy of Ukraine in the post-war period, but under the conditions of compliance with the "build back better" approach, implementation of energy efficiency measures, expansion of the use of renewable energy sources, other measures for decarbonization and technological modernization of the energy sector, can occur without increasing of GHG emissions in the "Energy" and "Industrial processes and product use" sectors.

Under the conditions of the WEM scenario, GHG emissions in the "Energy" and "Industrial processes and product use" sectors can decrease by 28% in 2025 compared to 2020, after which, without the implementation of additional measures, but with the growth of the economy, there will be an increase emissions by 2050, although the 2020 level will not be reached. At the same time, the implementation of additional planned measures (WAM scenario) can lead to a significant reduction in GHG emissions by 2030 (-49% relative to 2020) and a further significant reduction by 2050 (-76% relative to 2020).). Moreover, under the WAM scenario, it is possible to achieve net-zero GHG emissions in the electricity and heat generation sector before 2050, with the achievement of negative CO₂ emissions through the combination of bioenergy and carbon capture and storage (CCS) technologies. Although the ESU declares that the energy sector will be climate neutral by 2050, policies and measures are currently insufficient to achieve this goal.

Greenhouse gas emissions in the "Agriculture" sector

Greening of agriculture determines the need for environmentally sound development of this industry, which is accompanied by the introduction of information and electronic communication technologies, improvement of agricultural techniques of soil cultivation and crop cultivation technologies, sustainable development of animal husbandry, both in the context of animal breeding technologies and manure management. Given the identified priorities and tasks of sustainable climate-oriented development from existing measures to create favorable conditions for the development of a competitive, sustainable and diversified agricultural sector, the WAM scenario is focused on the expanded implementation of two policies in agriculture (see Table 5.2), which will contribute to the reduction of GHG emissions.

Organic crop production has been known for a long time, but its potential is only partially realized. Its climate orientation plays an important role in adapting to climate change, mitigating its consequences and preserving biodiversity, and therefore is a priority tool for the "green transformation" of agriculture.

The introduction of information and electronic communication technologies in crop production is the result of scientific and technical development and has a significant impact on the sustainable development of agriculture. Their use contributes to environmental control of lands, their monitoring and optimization of applied agrotechnical methods and measures.

Table 5.2. Potential impact of policies on reducing emissions in agriculture

Policy	Quantitative goals	Investment needs, million euros	Reduction of greenhouse gas emissions, million tons of CO ₂ -eq
Promoting the development of organic crop production	1.1 million hectares	-	1.1
Disseminating the use of information and electronic communication technologies in crop production	-	4,000	0.4

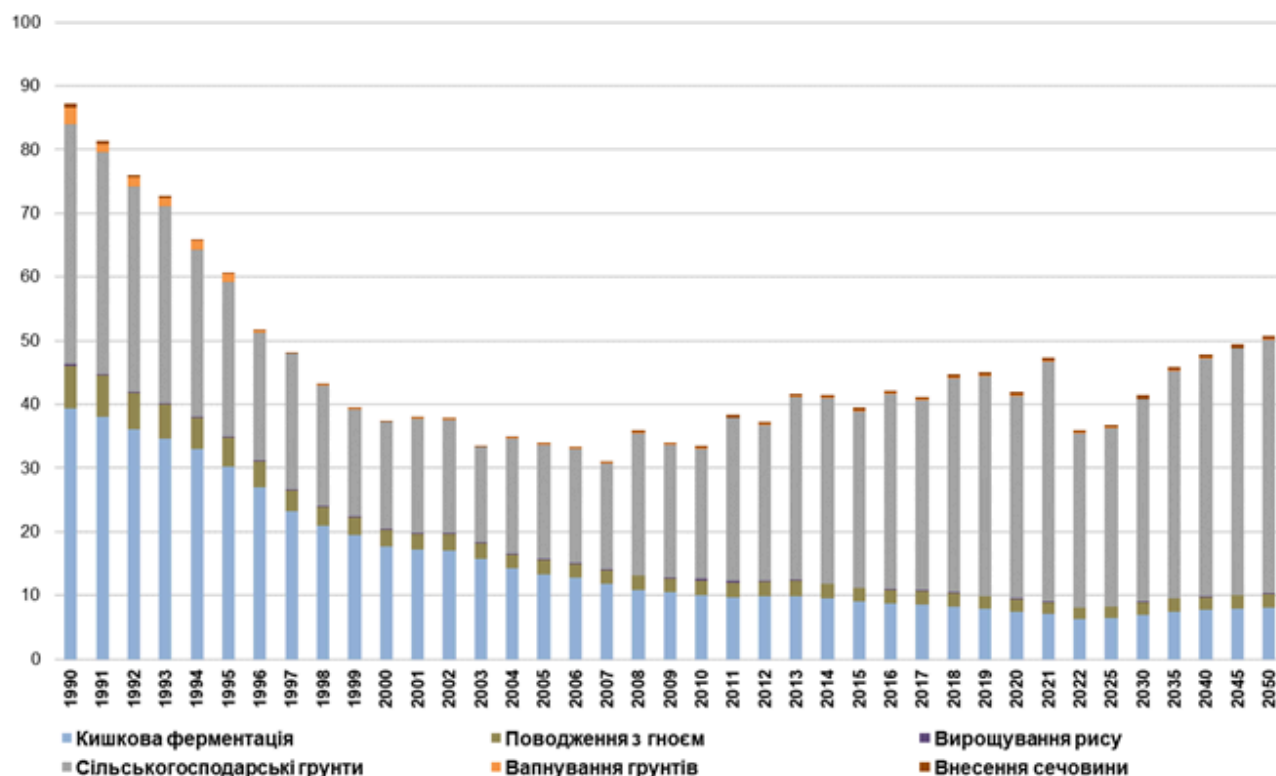
Taking into account the historical trend of agricultural development, as well as the uncertainty regarding the end of hostilities, we can assume a low degree of spread of these practices and technologies (Table 5.3). However, even incomplete use of their potential will have an impact on the reduction of GHG emissions in agriculture.

Table 5.3. Reduction of greenhouse gas emissions as a result of policy implementation, million tons of CO₂-eq

Policy	2025	2030	2035	2040	2045	2050
Promoting the development of organic crop production	0.15	0.98	0.34	0.07	0.06	0.06
Disseminating the use of information and electronic communication technologies in crop production	0.01	0.04	0.11	0.14	0.16	0.18

Thus, GHG emissions in agriculture under the WAM scenario in 2030, 2040, and 2050 will be 41.4 million tons of CO₂-eq, 47.8 million tons of CO₂-eq, and 50.7 million tons of CO₂-eq, respectively. Compared to the base year of 1990, the projected greenhouse gas emissions in 2030, 2040, and 2050 under the WAM scenario will be 47.5%, 54.8%, and 58.2%, respectively.

Figure. 5.2. Projection of emissions from agricultural activities in Ukraine according to the WAM scenario, million tons of CO₂-eq



Greenhouse gas emissions in the "Waste" sector

The WAM scenario corresponds to strict compliance with the norms of the recently (in 2022) adopted Law "On Waste Management", and was formed based on the fact that the draft National Waste Management Plan of Ukraine until 2033⁴⁹⁹ and the draft Action Plan of the National Waste Management Plan of Ukraine until 2033⁵⁰⁰, which are planned to be approved in 2024, will be implemented in full. In more detail, the WAM scenario envisages a reduction in the share of household waste disposal to 30% by 2033 and to 20% in 2050; increasing the share of biogas disposal at landfills to 23% in 2030 and 36% in 2050, respectively; as well as the construction of new waste composting enterprises with low specific indicators of CH₄ and N₂O emissions.

It should be noted that, unlike the WEM scenario, under the WAM scenario, the increase in the share of biogas disposal at household waste landfills for the period up to 2030 will mainly occur due to the wider spread of biogas recovery technologies at household waste landfills, rather than flaring, because the approval of the "National Waste Management Plan of Ukraine until 2033" and the "Action Plan of the National Waste Management Plan of Ukraine until 2033" will stimulate the development of new regional household waste landfills with the parallel decommissioning of outdated household waste landfills.

⁴⁹⁹

<https://mepr.gov.ua/wp-content/uploads/2023/12/proyekt-Natsionalnyj-plan-upravlinnya-vidhodamy-23.11-002.docx>

⁵⁰⁰ https://mepr.gov.ua/wp-content/uploads/2023/12/Dodadok-1.-Plan-zahodiv-NPUV_23.11-1.docx

The methodology for the development of the WAM scenario, estimating GHG emissions and capital investments in the sector is provided in Appendix 4.

The list of key policies in the field of waste management under the WAM scenario is given in the table 5.4. below. The ways of implementing these policies are defined in detail in the draft of the National Waste Management Plan of Ukraine until 2033 and the draft Action Plan of the National Waste Management Plan of Ukraine until 2033.

Table 5.4. Key policies and measures of the WAM scenario

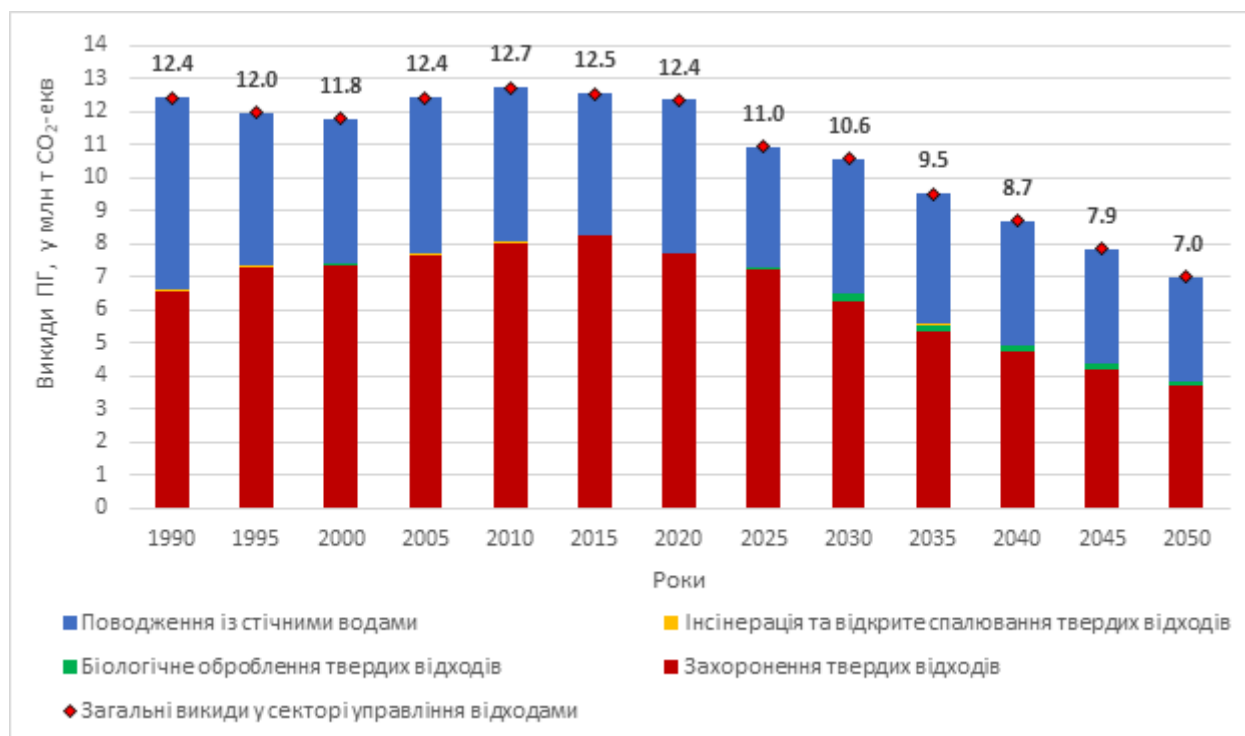
No	Title of the key policy	Quantitative indicator		
		2030	2033	2050
1	Disseminating the practice of household waste components reuse	8%* (full implementation of planned policies)	10%* (full implementation of planned policies)	10%*
2	Disseminating the practice of household waste recycling	26%* (full implementation of planned policies)	34%* (full implementation of planned policies)	35%*
3	Disseminating the practice of household waste organic components composting	12%* (full implementation of planned policies)	16%* (full implementation of planned policies)	20%*
4	Disseminating the practice of thermal treatment of household waste (with obtaining useful energy)	8%* (full implementation of planned policies)	10%* (full implementation of planned policies)	15%*
5	Increasing the amount of disposal (recovery and flaring) of landfill biogas at landfills	23%** , of which: 19% – recovery; 4% – flaring (the quantitative indicator is not explicitly established by law)	29%** , of which: 23% – recovery; 6% – flaring (the quantitative indicator is not explicitly established by law)	36%** , of which: 30% – recovery; 6% - flaring

* - share of the total volume of generated waste;

** - share of the total volume of methane produced.

According to the WAM scenario, GHG emissions in the waste management sector will continuously decrease and in 2030 will reach 10.6 million tons of CO₂-eq., which is 15% lower than the level of emissions in 1990. In the future, emissions will continue to decrease, and in 2050 they will amount to 7 million tons of CO₂-eq, which is 44% less than the level of 1990. Detailed GHG emissions in the waste management sector until 2050 are shown in Figure. 5.3.

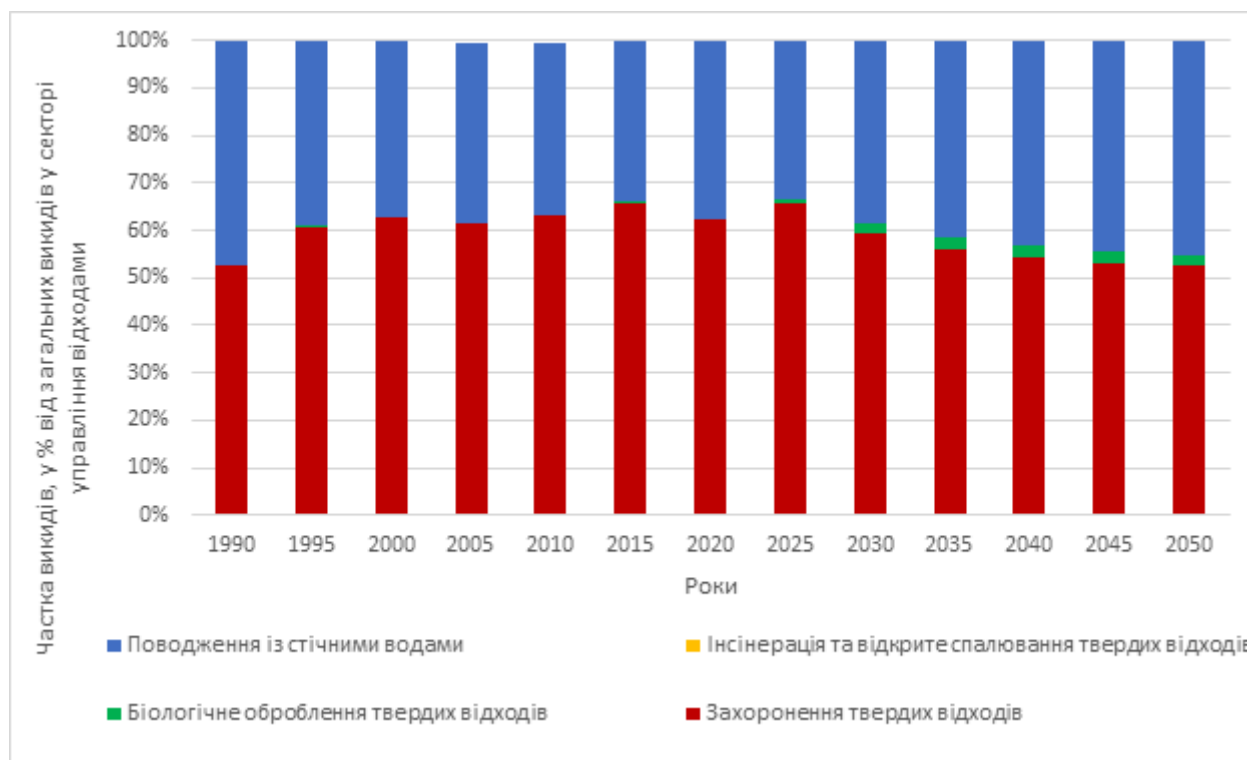
Figure. 5.3. GHG emissions in the waste management sector under the WAM scenario; for the period 1990-2020 - statistical data, and for the period 2025-2050 - projections; according to IPCC categories



Under the WAM scenario, the structure of emissions in the waste management sector will undergo significant changes compared to 2020. Thus, solid waste disposal landfills will remain the main source of GHG emissions in the sector, but their share will decrease from 62% in 2020 to 59% in 2030, and to 53% in 2050. The share of emissions caused by wastewater treatment will increase accordingly starting in 2030, reaching 45% in 2050 compared to 38% in 2020. As in the WEM scenario, in the WAM scenario the only source in which a significant increase in GHG emissions is expected is the biological treatment of solid waste, emissions from which will increase from 7.5 thousand tons of CO₂-eq. (0.1% of total emissions in the sector) in 2020 to 207.9 thousand tons of CO₂-eq. in 2030, and then gradually decrease to 140.6 thousand tons of CO₂-eq. (2% of total emissions in the sector) in 2050. Such a considerable increase in emissions from the biological treatment of solid waste in the period up to 2030 will be caused by the intensive dissemination of the household waste composting practice in Ukraine.

The gradual reduction of GHG emissions from the biological treatment of solid waste after 2030 will be associated with the introduction of modern technologies for composting of household waste organic components with lower methane and nitrous oxide emission factors. Greenhouse gas emissions from thermal methods of waste treatment (*note: without obtaining useful energy*) will increase from 0.1% of total emissions in the waste management sector in 2020 to 0.2% in 2050. Although these emissions will not increase in absolute terms, the increase in the share of emissions in the sector will be caused by a significant reduction in GHG emissions in other emission sources. The detailed structure of emissions by individual types of activities in the waste management sector until 2050 is shown in Fig. 5.4.

Fig. 5.4. The structure of GHG emissions in the waste management sector under the WAM scenario; for the period 1990-2020 - statistical data, and for the period 2025-2050 - projections; according to IPCC categories



In the WAM scenario, the main factors that will determine trends in GHG emissions in the waste management sector are:

- intensive reduction of the share of landfilling of household waste by 2033, followed by a more moderate reduction of the share of landfilling of household waste by 2050;
- intensive deployment of biogas disposal technologies at landfills until 2033 with a further moderate increase in the share of biogas disposal until 2050;
- reduction of specific emissions of methane and nitrous oxide during composting of household waste after 2033.

The key risks to reducing GHG emissions under the WAM scenario are:

- slow deployment of the infrastructure for recycling of waste materials;
- low efficiency of biogas disposal technologies, which should be introduced at household waste landfills with a low biogas flow rate;
- implementation of technologies and practices for composting of household waste organic components with high specific emissions of methane and nitrous oxide.

Sensitivity analysis in the waste management sector

A sensitivity analysis in the waste management sector was carried out in order to assess the additional (compared to the WAM scenario) potential for reducing GHG emissions from the implementation of the key principles of the circular economy (minimizing the generation of waste and pollutants, maximizing the cycle of products and materials, as well as restoring natural resources) for the period until 2050.

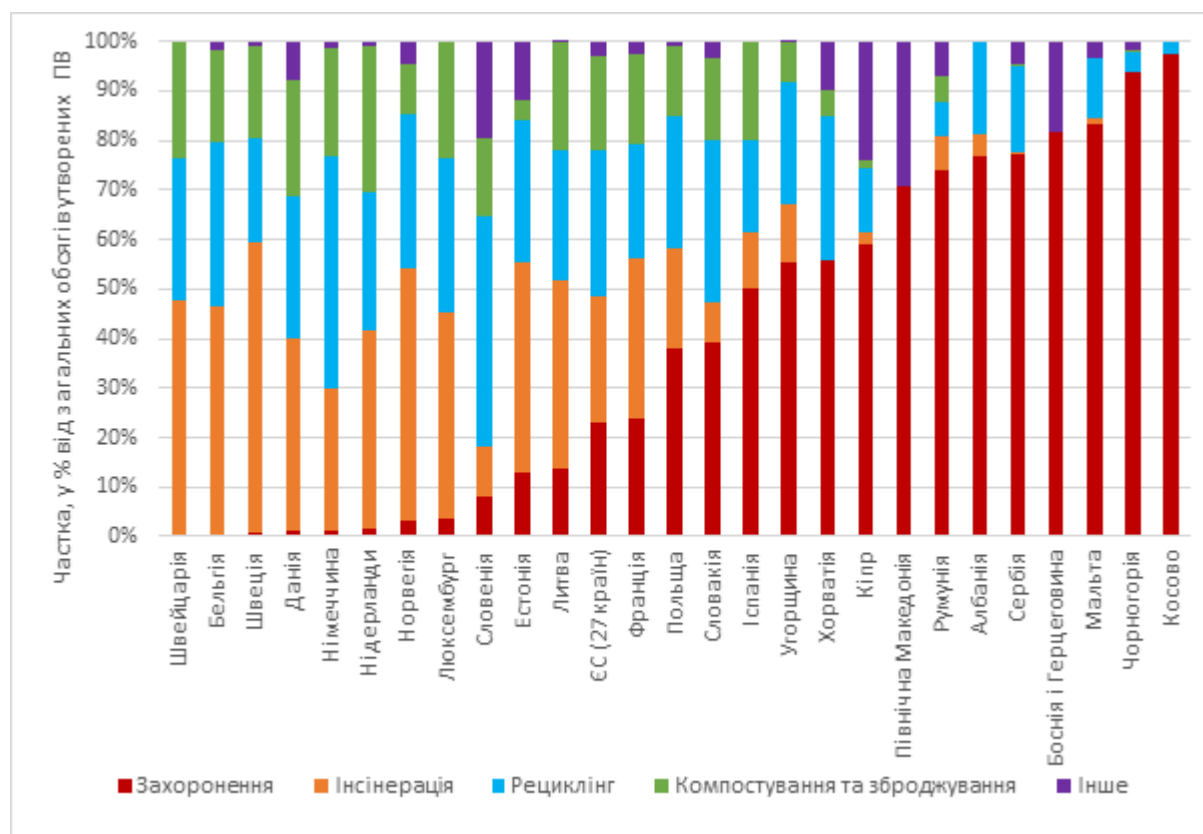
According to the conditions of the sensitivity analysis, such documents as the draft of the "National Waste Management Plan of Ukraine until 2033" and, accordingly, the draft of the "Action Plan of the National Waste Management Plan of Ukraine until 2033" will be completed on time and in full, that is, in fact, in the period from 2024 to 2033, the waste management system in Ukraine will develop according to the WAM scenario. At the same time, during the specified period, the conditions will be created for the widespread implementation of the principles of the circular economy in the future. As a result, by 2050 Ukraine will

implement advanced waste management practices that are already successfully operating in some European countries that have made the most progress on the way to creating their own circular economies.

As part of the sensitivity analysis, the additional potential for reducing GHG emissions in the case of a gradual reduction in the share of the household waste disposal from 30% in 2033 to 1% in 2050 was investigated. As an example of such an active waste management system, Germany was considered - a country in which less than 2% of the total amount of generated waste is landfilled and about 47% of generated waste is recycled. Detailed statistics on the handling of household waste in European countries are illustrated in figure 5.5.

As additional measures to reduce GHG emissions, the sensitivity analysis also considered an increase in the share of biogas disposal at landfills from 29% in 2033 to 60% (compared to 36% under the WAM scenario) in 2050 and an increase in the share of biogas disposal generated by cleaning of household wastewater, from 0% in 2033 to 94% in 2050. As an example, the United Kingdom was considered - a country in which the shares of disposal of biogas at household waste landfills and the biogas of household wastewater are the largest among the countries of Annex I of the UN Framework Convention on Climate Change.

Figure. 5.5. Statistics of solid household waste management in European countries as of 2022



Note: The indicators are calculated based on the data of the Eurostat database "Solid household waste management", at the link:

https://ec.europa.eu/eurostat/databrowser/view/env_wasmun/default/table?lang=en&category=env.env_was.env_wasst

Table 5.5. Key additional policies and measures considered for the sensitivity analysis of the waste management sector

No	Title of the key policy	Quantitative indicator		
		2033	2050	
		WAM	WAM	Sensitivity analysis
1	Disseminating the practice of household waste components reuse	10%*	10%*	10%*
2	Disseminating the practice of household waste recycling	34%*	35%*	37%*
3	Disseminating the practice of household waste organic components composting	16%*	20%*	24%*
4	Disseminating the practice of thermal treatment of household waste (with obtaining useful energy)	10%*	15%*	28%*
	In total, the share of the household waste disposal	30%*	20%	1%*
5	Increasing the amount of disposal (recovery and flaring) of biogas at landfills	29%**	36%**	60%**
6	Implementation of the practice of neutralization (recovery and flaring) of biogas at facilities for the treatment of household wastewater	0%**	0%**	94%**

* - share of the total volume of generated waste;

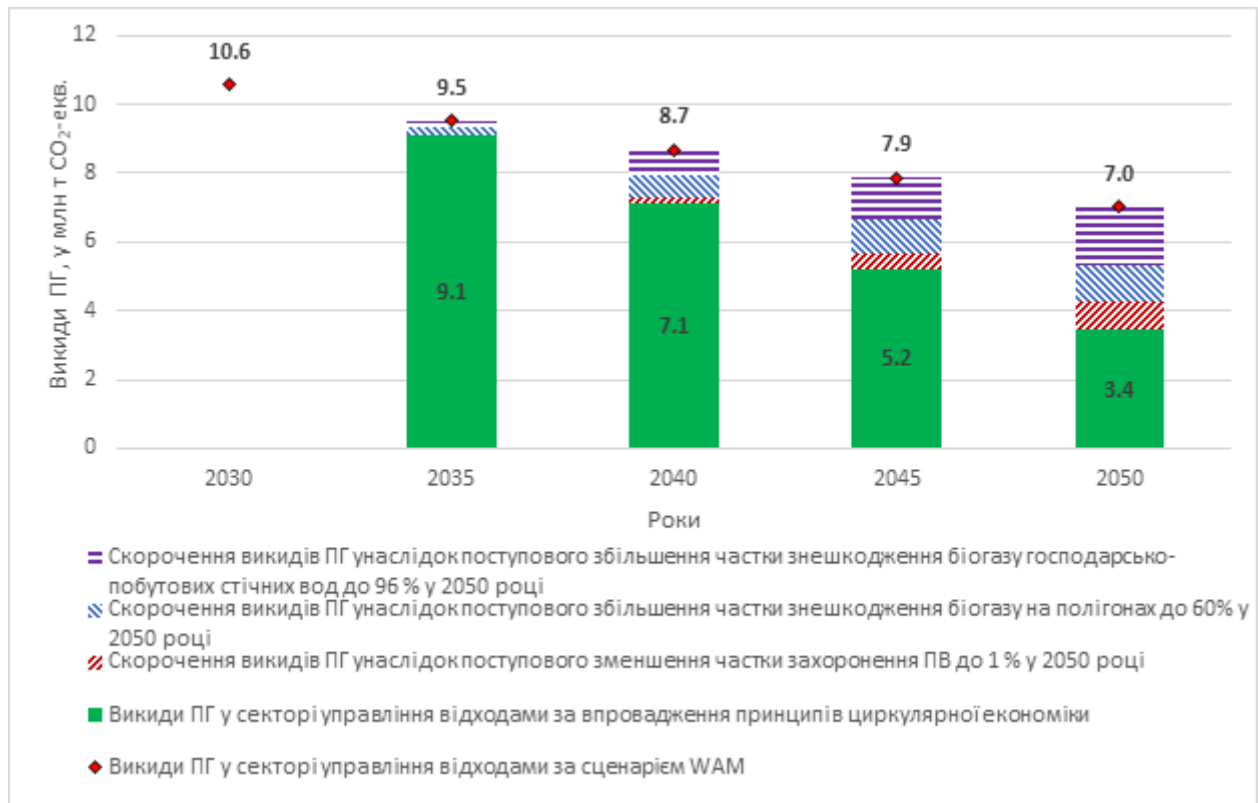
** - share of the total volume of methane produced.

According to the results of the conducted sensitivity analysis, the following was found. The gradual implementation of the world-best practices in the field of waste management will allow to reduce annual GHG emissions in the "Waste" sector by 3.6 million tons of CO₂-eq. by 2050 or by 51% compared to the WAM scenario. Thus, annual GHG emissions in the waste management sector in 2050 will amount to 3.4 million tons of CO₂-eq., or 28% of the corresponding indicator in 1990.

Further, it follows from the sensitivity analysis that the biggest contribution to the additional reduction of annual GHG emissions compared to the WAM scenario will be the development of the biogas (which is formed during the treatment of household wastewater) disposal technologies, - about 1.7 million tons of CO₂-eq in 2050 year; 1.1 million tons of CO₂-eq. reduction of GHG emissions - as a result of the intensification of biogas disposal processes at landfills; and about 0.8 million tons of CO₂-eq. reduction of GHG emissions - as a result of the almost complete ban on landfilling of waste in 2050.

The detailed results of the sensitivity analysis in the waste management sector are illustrated in figure 5.6 below.

Figure. 5.6. Sensitivity analysis in the waste management sector



Further, the sensitivity analysis revealed that in the long term, on the way to the introduction of a circular economy in Ukraine, the contribution of the following emission sources to the total GHG emissions in the waste management sector will increase significantly:

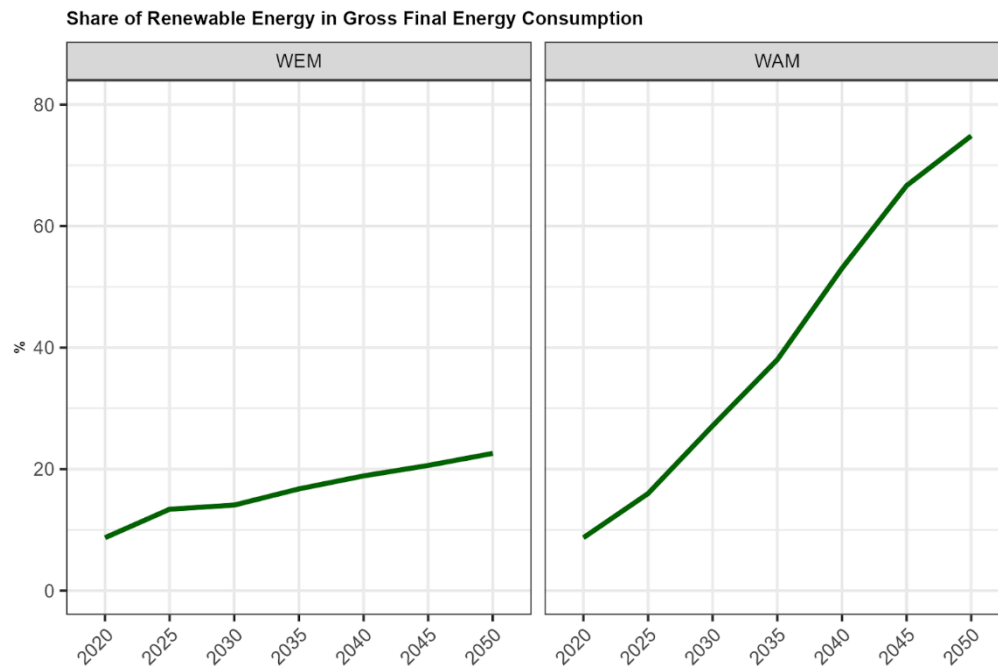
- closed landfills and waste landfills, CH₄ emissions;
- objects of centralized treatment of wastewater and their sediments, N₂O emissions;
- decentralized facilities for the accumulation of human waste, CH₄ emissions.

Therefore, after the implementation of the priority measures defined in the draft "Action Plan of the National Waste Management Plan of Ukraine until 2033", in order to ensure the further reduction of GHG emissions in the waste management sector for the period after 2033, it will be necessary to develop and implement additional measures designed to stimulate the reduction of GHG emissions from the above-mentioned sources of GHG emissions.

Renewable energy

Considering the current and potential consequences of Russia's full-scale military aggression against Ukraine, achieving the goal of 27% RES in the structure of the gross final consumption of energy resources seems extremely ambitious. Nevertheless, the results of modeling under the WAM scenario show that it is theoretically possible under the conditions of full implementation of measures and wide use of RES, primarily in industry, individual heating of houses, in particular, increasing the use of not only solid biofuels, but also renewable gasses. By 2050, the share of RES in the structure of gross final energy consumption may exceed 70% (Figure. 5.7).

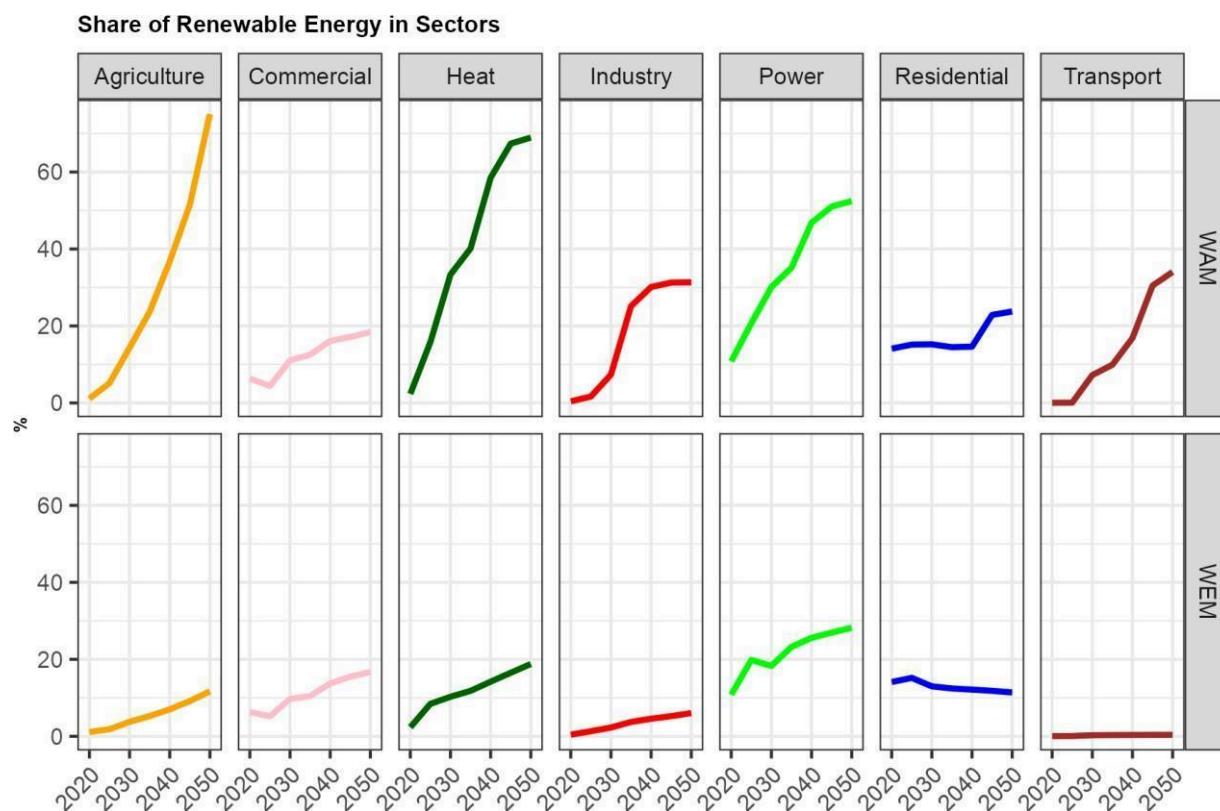
Figure. 5.7. The share of RES in the structure of the gross final consumption of energy resources according to the WEM and WAM scenarios, %



Source: calculations of the Institute of Economics and Forecasting of the National Academy of Sciences of Ukraine based on the TIMES-Ukraine model

For comparison, Fig. 5.8 shows the shares of direct consumption and use of RES in various sectors of the economy, without taking into account "green" electrical and thermal energy received (consumed) from networks.

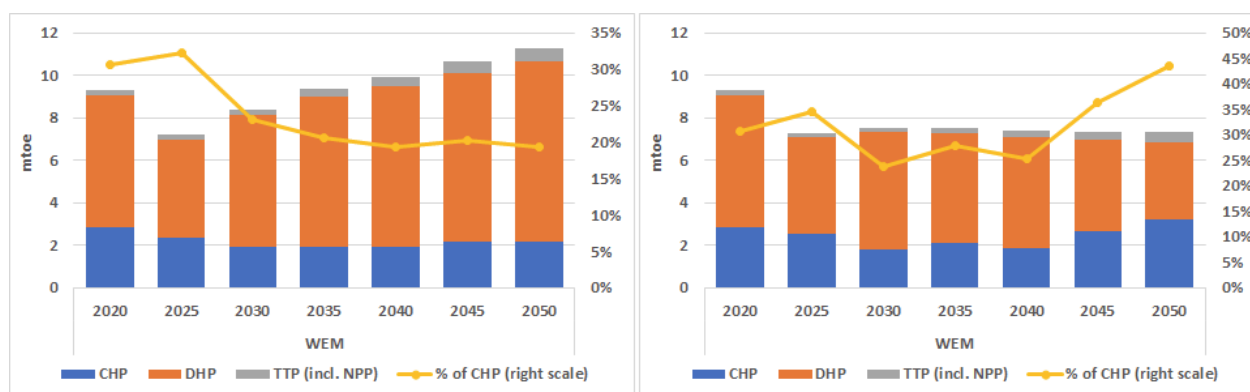
Figure. 5.8. The share of RES in the structure of consumption and use of energy resources in various sectors of the economy according to the WEM and WAM scenarios, %



Source: calculations of the Institute of Economics and Forecasting of the National Academy of Sciences of Ukraine based on the TIMES-Ukraine model

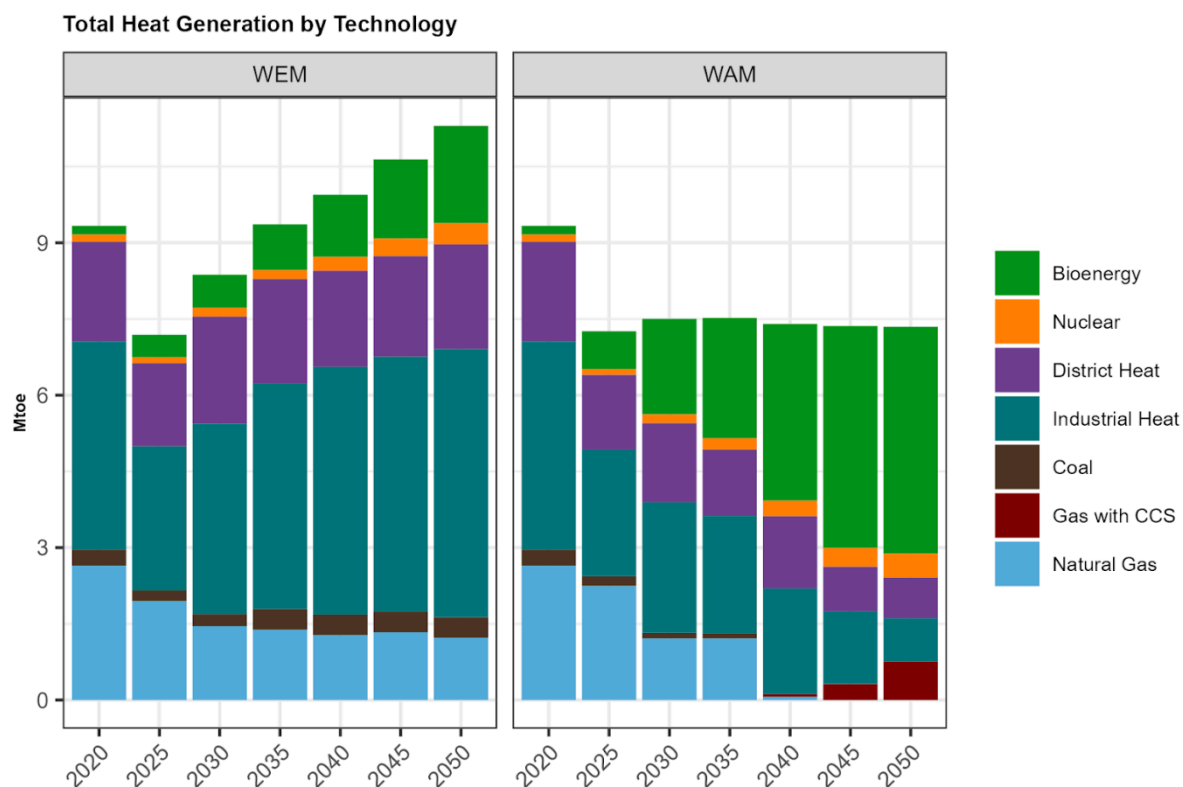
The simulation results of the WEM and WAM scenarios using the TIMES-Ukraine model show that highly efficient cogeneration (CHP, especially on RES) will show an increase in its share in the structure of thermal energy production, compared to the corresponding indicator in the WEM scenario, but will not exceed 50% (Fig. 5.9).

Figure. 5.9. Thermal energy production in the WEM and WAM scenarios, Mtoe



In fig. 5.10 shows the production of thermal energy by energy types with the allocation of centralized heat supply, which is significantly reduced due to the planned measures of large-scale thermal modernization of buildings.

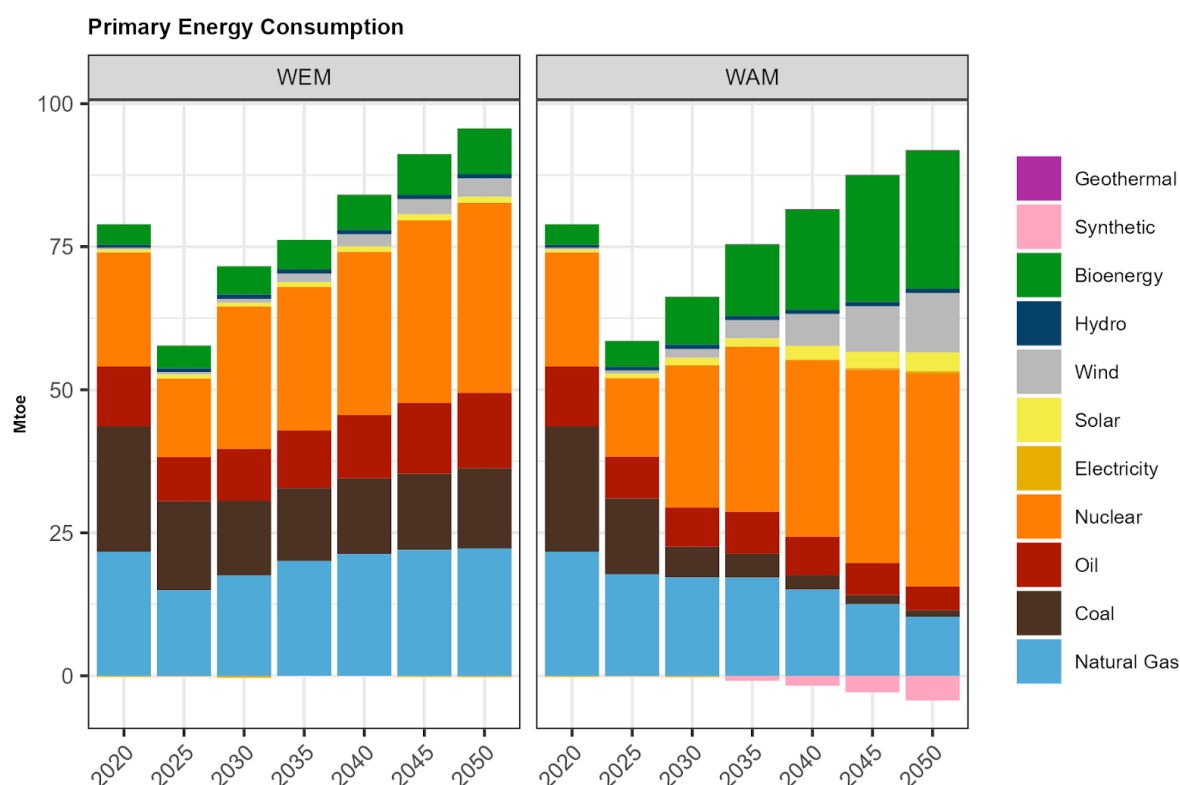
Figure. 5.10. Production of heat energy by types of energy with the allocation of centralized heat supply in the WEM and WAM scenarios, Mtoe



Source: calculations of the Institute of Economics and Forecasting of the National Academy of Sciences of Ukraine based on the TIMES-Ukraine model

In addition, the simulation results under both scenarios (WEM and WAM) confirm that the post-war recovery of the economy and the reintegration of the temporarily occupied territories of Ukraine will contribute to a significant increase in the demand for energy resources, especially in the first 5-10 years. At the same time, both current (WEM) and additional (WAM) policies and measures in the field of energy efficiency and renewable energy will not ensure the stabilization of primary energy consumption, especially if the policies of exporting renewable gases (biomethane, hydrogen) and increasing nuclear energy are implemented (Fig. 5.11).

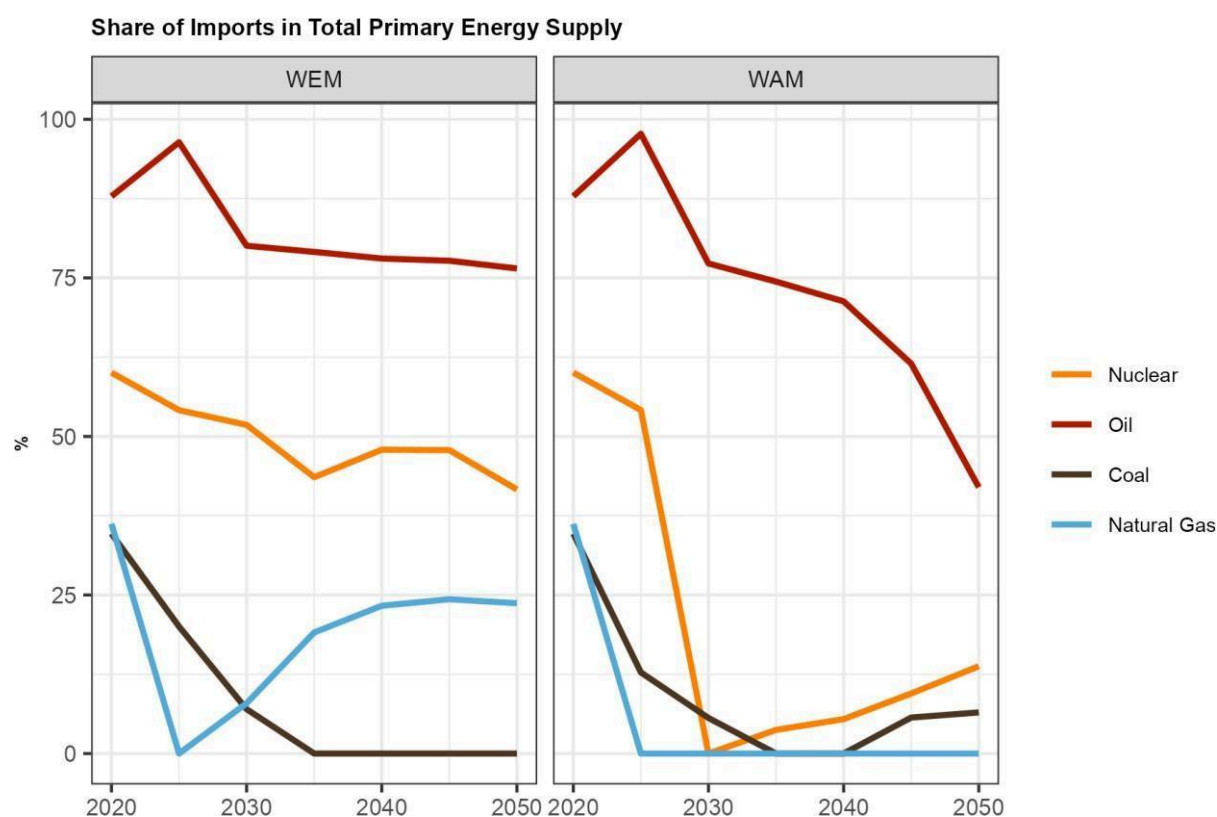
Figure. 5.11. Primary energy consumption according to the WEM and WAM scenarios, Mtoe



Source: calculations of the Institute of Economics and Forecasting of the National Academy of Sciences of Ukraine based on the TIMES-Ukraine model

Under the conditions of the WAM scenario, the issue of dependence on imported energy resources will not be removed only for oil and oil products, the share of which in the structure of the UPP will be almost 80% by 2030 and will decrease to only 40% in 2050. For the rest of the fossil fuels, under the conditions implementation of all related planned policies and measures, from 2030 the share of their imports will be less than 20% (5.120).

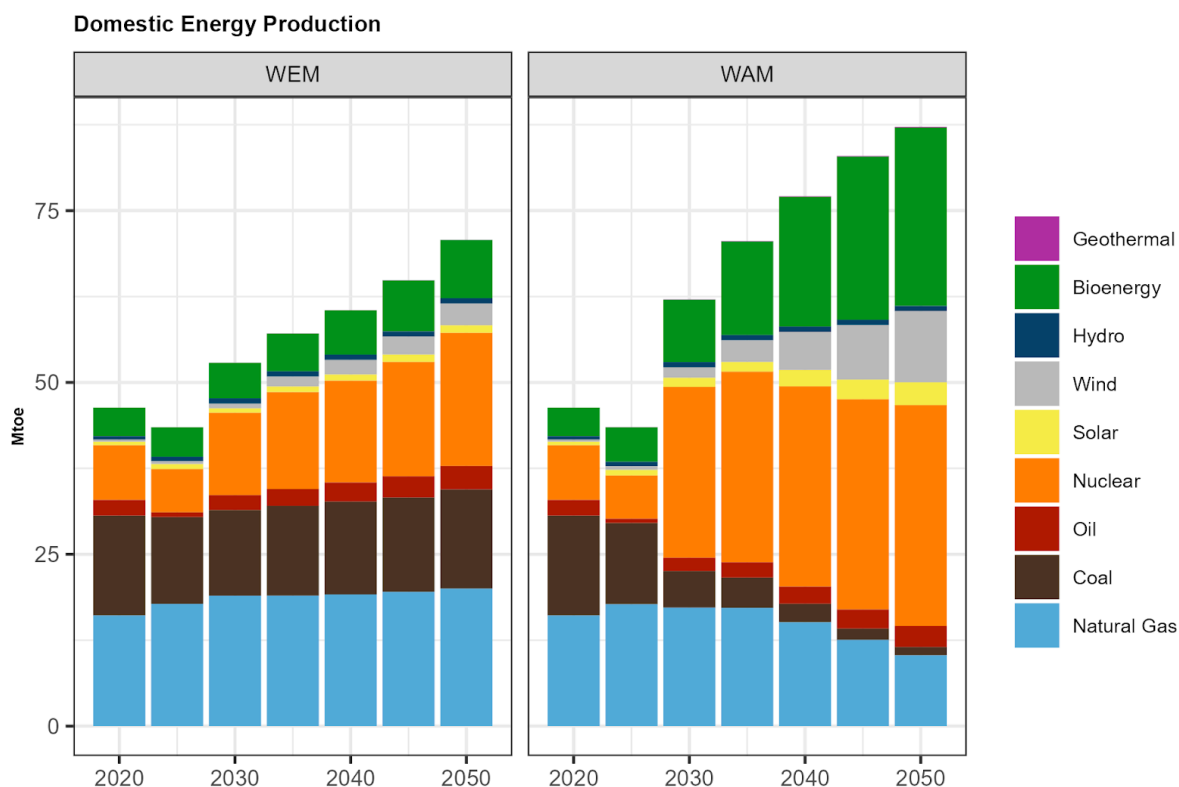
Figure. 5.12. Forecast of providing Ukraine's economy with its own energy resources according to the WEM and WAM scenarios, %



Source: calculations of the Institute of Economics and Forecasting of the National Academy of Sciences of Ukraine based on the TIMES-Ukraine model

According to the WEM scenario, an increase in the production of energy resources is predicted, primarily uranium ore production, as well as renewable energy resources, while under the WAM scenario, in addition to a significant increase in uranium ore production, significant rates of development of the potential of bioenergy and wind energy should also be ensured. At the same time, the production of carbon-intensive fossil energy resources will decrease under the pressure of decarbonization and other measures.

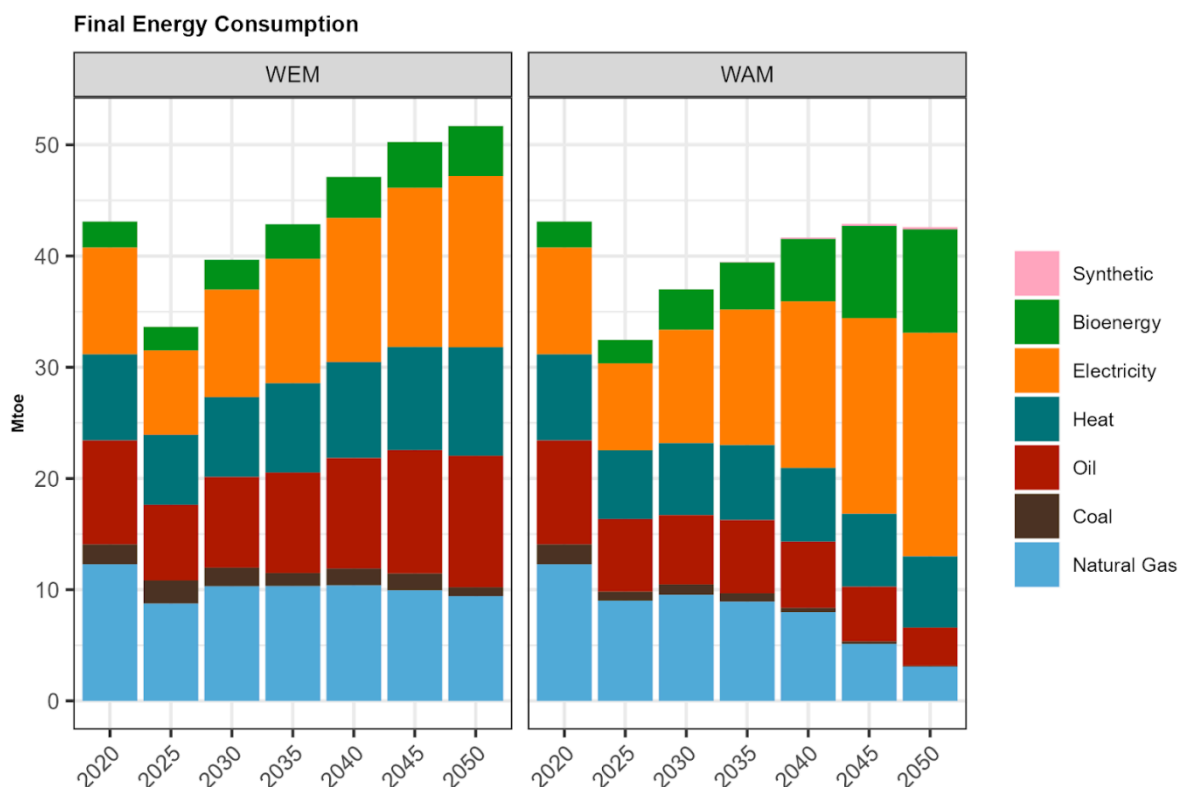
Figure. 5.13. Forecast of production and supply of energy resources according to WEM and WAM scenarios, Mtoe



Source: calculations of the Institute of Economics and Forecasting of the National Academy of Sciences of Ukraine based on the TIMES-Ukraine model

The trajectory of final energy consumption is similar to the trajectory of primary energy consumption, however, the growth rate in the WEM scenario is slightly higher, and in the WAM scenario there is a stabilization of final energy consumption, which indicates an increase in the efficiency of the energy transformation sector in both scenarios, primarily the power generation sector and warm. At the same time, in both scenarios, especially in WAM, there is also an increase in the share of electrical energy, as well as a significant increase in the direct consumption of bioenergy resources, in particular, biomethane. Thanks to the reform of carbon pricing and a significant increase in the cost of CO₂, biomethane can become an economically attractive fuel in industry from about 2030, and in 2040-2050 in the remaining sectors, reaching 5.3 billion m³ in final energy consumption (approximately 50% biomethane will be consumed in industry). But, according to the simulation results, there will be almost no direct final consumption of hydrogen without special measures to support it.

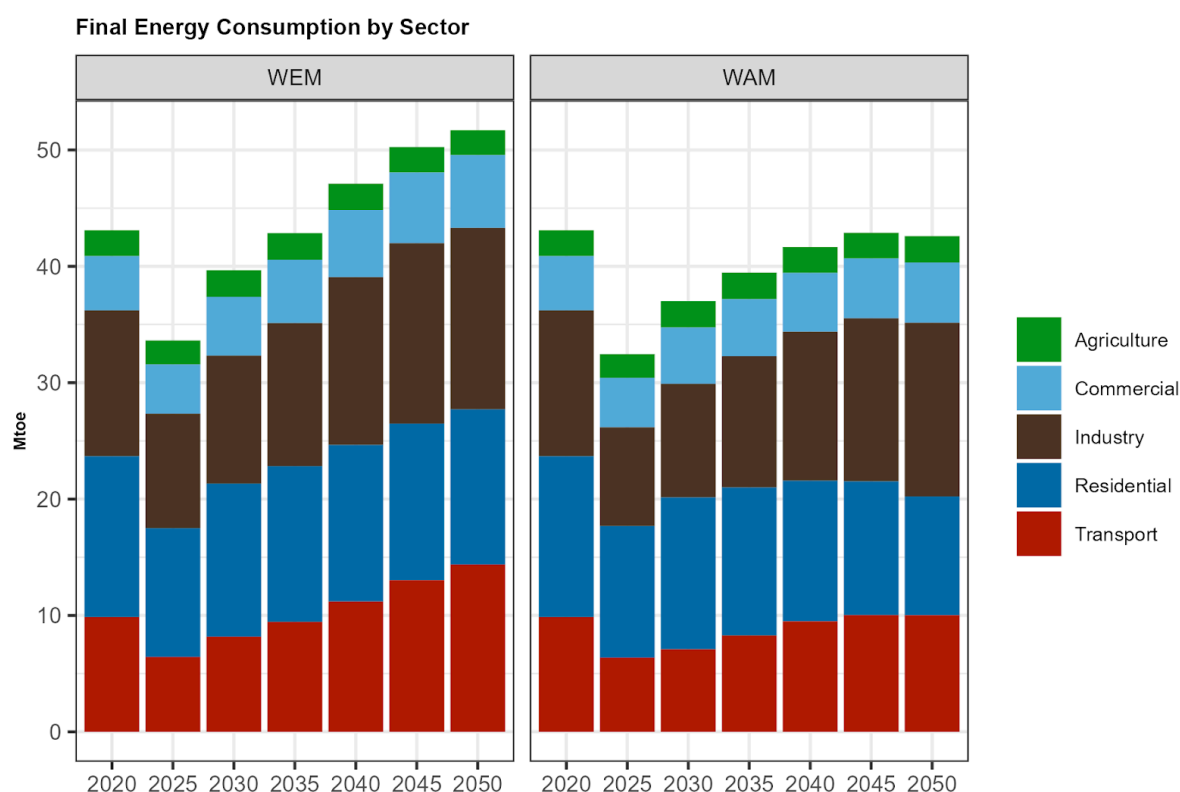
Figure. 5.14. Final consumption by types of energy according to WEM and WAM scenarios, Mtoe



Source: calculations of the Institute of Economics and Forecasting of the National Academy of Sciences of Ukraine based on the TIMES-Ukraine model

After a radical drop in energy consumption in 2022 as a result of the Russian Federation's full-scale invasion of Ukraine, all sectors of final energy consumption will already see an increase in energy demand caused by the recovery of the economy and the reintegration of the temporarily occupied territories, which will continue until 2030. At the same time, additional planned measures on energy efficiency, development of RES and other dimensions of NECP will allow to reduce energy needs in the same way in all sectors.

Figure. 5.15. Final energy consumption by sector according to the WEM and WAM scenarios, Mtoe



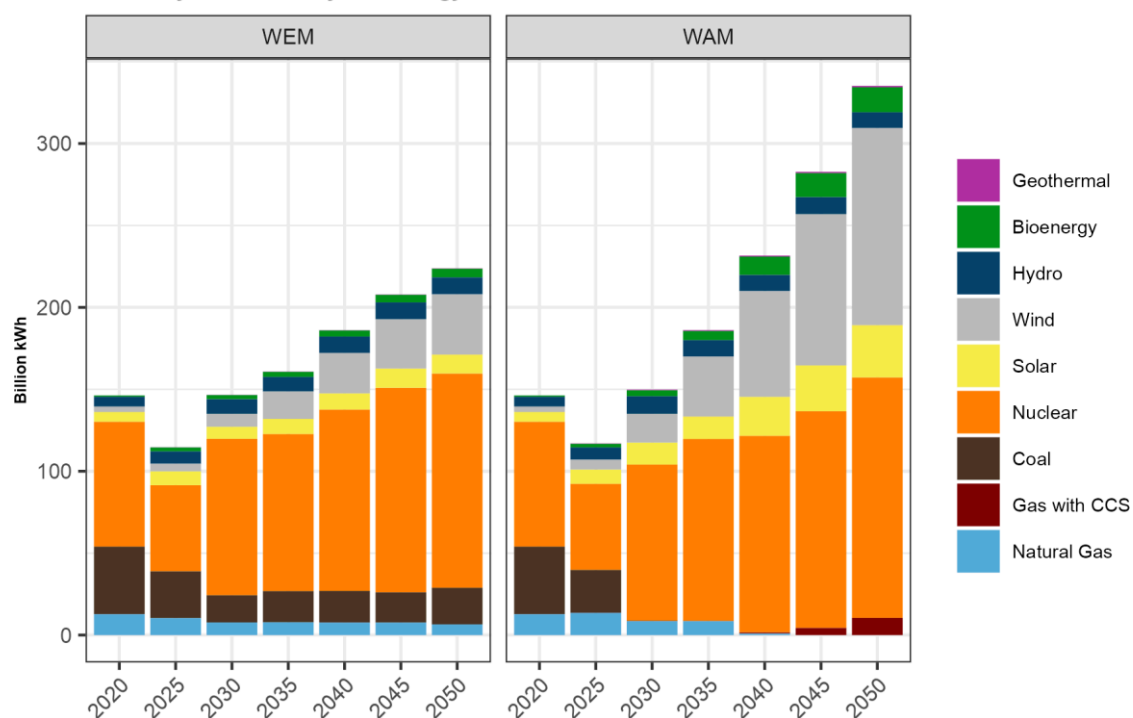
Source: calculations of the Institute of Economics and Forecasting of the National Academy of Sciences of Ukraine based on the TIMES-Ukraine model

In figures 5.16 and 5.17 show the dynamics and structure of electricity production and capacities of power generation facilities in Ukraine under the WEM and WAM scenarios, respectively. As mentioned above, based on the simulation results using the TIMES-Ukraine model, in the WEM scenario, nuclear power shows an extraordinary increase in generation. In the WAM scenario, nuclear power has similar dynamics and volumes of electricity production, but due to the increase of total electricity production by more than 70% in 2050 compared to WEM, additional electricity needs will be covered primarily by wind energy. Thus, the share of nuclear power plants, maintaining its dominant position until 2035, will decrease in 2040-2050, reaching 37-38%.

It is important that the simulation results of the WAM scenario show that in order to achieve the national goal of 27% of RES in the structure of gross final energy consumption in 2030, it is necessary that the share of RES in the structure of electricity generation is at least 30%, which exceeds the goal of the ESU, which is 25 %.

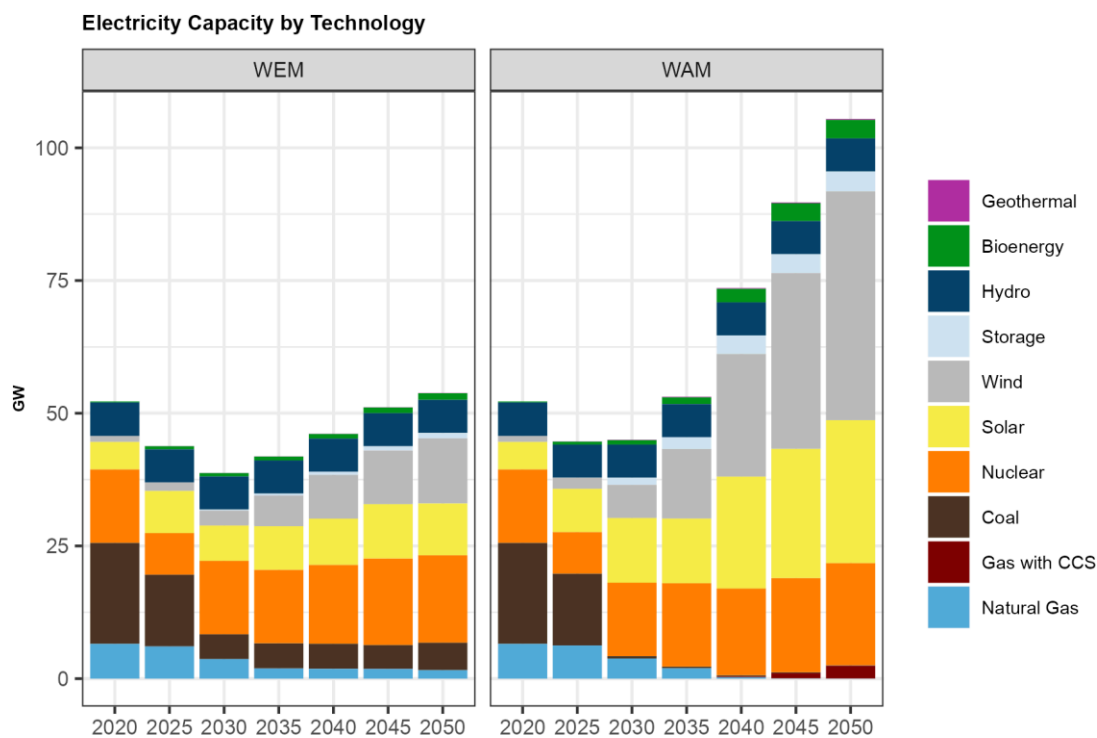
Under such conditions of the WAM scenario simulation, the share of installed capacity of wind turbines and thermal power plants may exceed the installed capacity of nuclear power plants by several times, while a sufficient number of storage capacities and carbon capture and storage systems at bioenergy thermal power plants and thermal power plants must be built.

Figure 5.16. Electricity production according to WEM and WAM scenarios, billion kWh
Electricity Generation by Technology



Source: calculations of the Institute of Economics and Forecasting of the National Academy of Sciences of Ukraine based on the TIMES-Ukraine model

Figure 5.17. Installed capacity of power generation facilities according to WEM and WAM scenarios, GW
Electricity Capacity by Technology



Source: calculations of the Institute of Economics and Forecasting of the National Academy of Sciences of Ukraine based on the TIMES-Ukraine model

ii. *Assessment of policy interactions (between existing policies and measures and planned policies and measures within a policy dimension and between existing policies and measures and planned policies and measures of different dimensions) at least until the last year of the period covered by the plan, in particular to establish a robust understanding of the impact of energy efficiency / energy savings policies on the sizing of the energy system and to reduce the risk of stranded investment in energy supply*

Table 5.6. The main results of the simulation of RES development in Ukraine according to the WEM and WAM scenarios

Heat energy production (stations heat supply), Mtoe	9.3	8.4	9.9	11.3	9.3	7.5	7.4	7.3
Coal, %	13.8	14.7	11.0	10.0	13.8	10.2	1.9	0
Gas, %	61.9	58.6	64.7	60.4	61.9	39.6	11.0	13.1
Biofuel and waste, %	9.5	17.8	14.7	19.0	9.5	40.5	78.1	75.2
Waste heat, %	9.1	5.7	5.5	5.6	9.1	5.9	4.9	4.7
Share of RES, %	9.5	17.7	14.7	19.0	9.5	40.5	78.1	75.2

Source: State Statistics Service, State University "Institute of Economics and Forecasting of the National Academy of Sciences of Ukraine"

The table below presents in detail the structure of consumption of energy resources in the five main final sectors of the economy.

Table 5.7. Final energy consumption by sectors and types of fuel, Mtoe

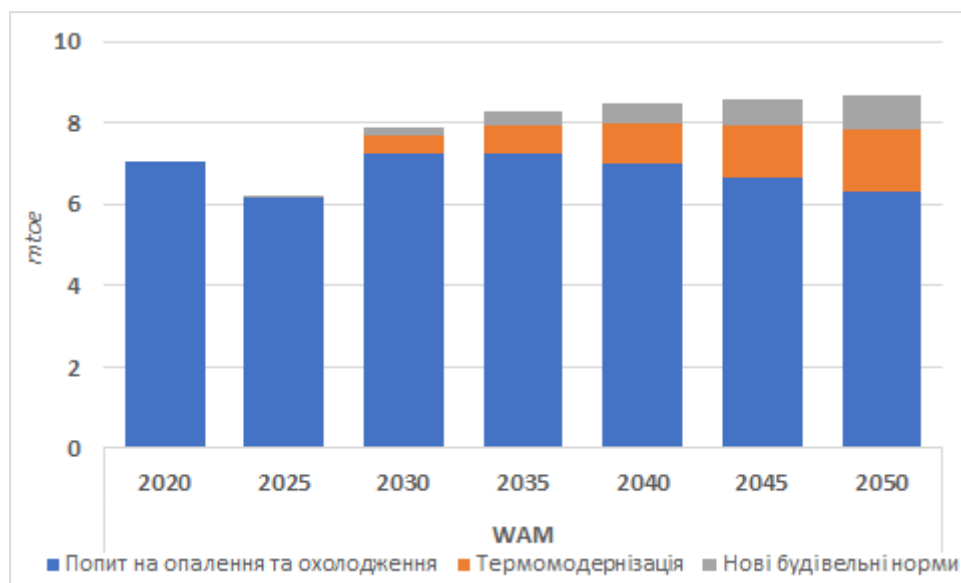
	WEM scenario				WAM scenario			
	2020	2030	2040	2050	2020	2030	2040	2050
Final energy consumption in the service sector								
FEC in the service sector, Mtoe	4.7	5.1	5.8	6.3	4.8	4.84	5.05	5.17
Coal, %	4.4	3.1	1.5	0.1	4.7	2.8	0.4	
Gas, %	15.2	15.7	12.7	5.6	14.6	12.6	3.5	0.7
Oil, %	2.4	0.01	0.3	0	4.9			
Thermal energy, %	44.5	42.6	43.1	48.8	44.9	44.0	49.2	49.3
Electricity, %	27.2	28.8	28.8	28.8	28.6	29.6	30.8	31.6
RES (direct consumption), %	6.3	9.7	13.7	16.7	6.3	11.1	16.1	18.4
Final energy consumption in industry								
FEC in industry, Mtoe	19.7	17.2	24.6	28.6	14.7	12.1	17.4	19.0
Coal, %	15.0	12.6	8.4	3.8	15.0	10.3	3.6	1.2
Gas, %	42.3	41.3	42.3	44.2	42.3	24.6	13.7	0.5
Oil, %	2.2	2.5	2.6	2.7	2.2	3.1	2.2	1.2
Thermal energy, %	18.5	18.0	17.4	17.2	18.5	22.4	15.0	10.3
Electricity, %	21.7	23.3	24.8	26.2	21.7	32.2	43.8	58.0
RES (direct consumption), %	0.5	2.3	4.6	6.0	0.5	7.4	30.1	31.3
Final energy consumption in the residential sector								
FEC in the residential sector	13.8	13.2	13.5	12.8	13.8	13.0	12.1	10.2
Coal, %	1	1	1	1.1	1	0.7		
Gas, %	48.2	50.9	50.6	50.5	48.8	51.4	48.9	27.4
Oil, %	0	0	0	0	0.2			
Thermal energy, %	13.9	12.5	11.8	11.3	14	9.9	9.6	15.2
Electricity, %	22.8	22.6	24.5	25.8	21.9	22.8	26.9	33.6
RES (direct consumption), %	14.1	13.0	12.1	11.4	14.1	15.2	14.6	23.8
Final energy consumption in the transport sector								
FEC in the transport sector, Mtoe	9.9	8.2	11.2	14.4	9.8	7.1	9.5	10.0
Coal, %	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Gas, %	16.5	10.0	13.9	14.0	16.5	5.5	10.5	1.3
Oil, %	75.8	78.2	71.5	69.4	75.7	66.9	51.8	31.9
Electricity, %	7.1	10.8	13.5	15.6	7.2	19.4	20.0	32.0
RES (direct consumption), %	0	0.3	0.3	0.4	0	7.2	16.9	34.0
Final energy consumption in agriculture								
FEC in agriculture, Mtoe	2.2	2.3	2.3	2.1	2.3	2.3	2.2	2.3
Coal, %	0.6	0.6	0.5	0.5	0.6	0.4	0.2	
Gas, %	8.7	8.2	7.8	7.4	8.5	7.1	4.8	
Oil, %	59.7	58.2	55.1	50.7	60.5	48.4	28.6	
Thermal energy, %	14.5	14.4	14.4	14.3	14.2	14.0	13.8	13.4

Electricity, %	15.3	14.9	15.1	15.4	15	15.7	15.7	11.5
RES (direct consumption), %	1,2	3.8	7.0	11.7	1,2	14.3	36.8	75.1

Source: State Statistics Service, State University "Institute of Economics and Forecasting of the National Academy of Sciences of Ukraine"

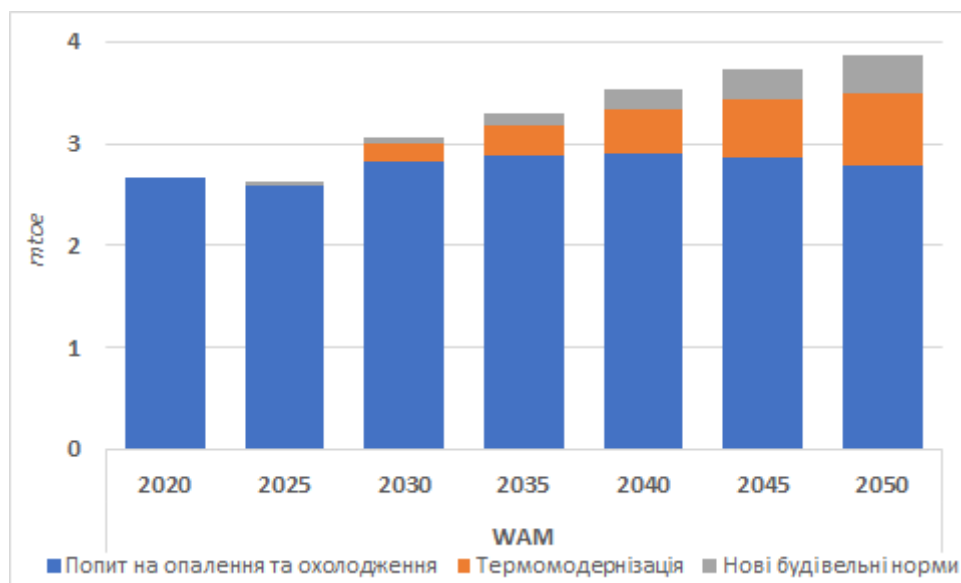
Figures 5.18 and 5.19 show the impact of additional (planned) policies and measures on reducing the demand for heating and cooling in the residential sector and the service sector, respectively, thanks to the thermal modernization of buildings, the introduction of new building codes. As can be seen from these figures, by 2030, thanks to such measures, it is possible to reduce about 8% of the total energy needs to meet the demand for heating and cooling, and by 2050, such a contribution may amount to 27-28%, that is, more than a quarter of the needs, without taking into account the increase energy efficiency of equipment, household appliances, etc.

Figure 5.18. The impact of policies and measures on thermal modernization and the introduction of new construction standards in the residential sector, Mtoe



Source: calculations of the Institute of Economics and Forecasting of the National Academy of Sciences of Ukraine based on the TIMES-Ukraine model

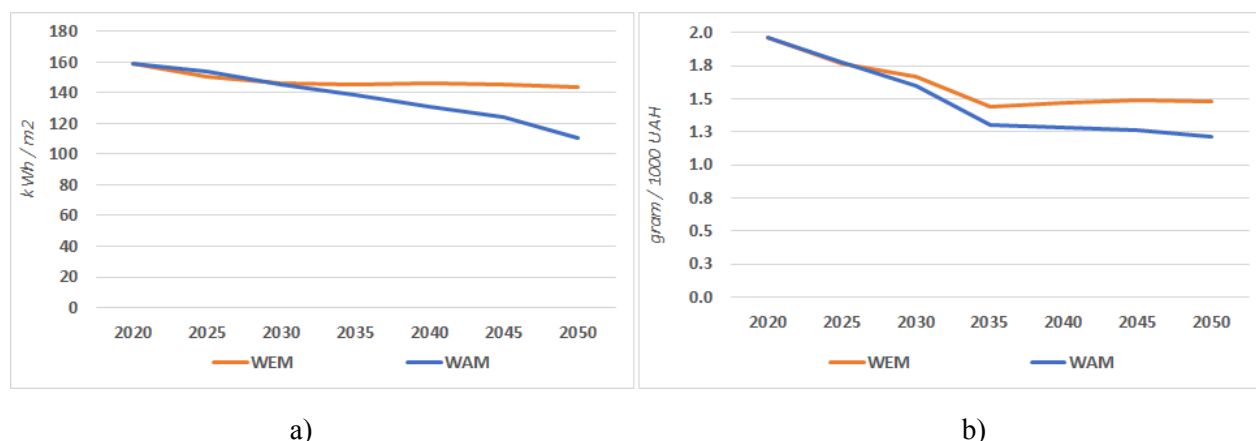
Figure 5.19. The impact of policies and measures on thermal modernization and the introduction of new construction standards in the service sector, Mtoe



Source: calculations of the Institute of Economics and Forecasting of the National Academy of Sciences of Ukraine based on the TIMES-Ukraine model

Figure 5.20 shows the impact of policies and measures on specific energy consumption under different scenarios in the residential (residential) sector and the service sector (commercial sector).

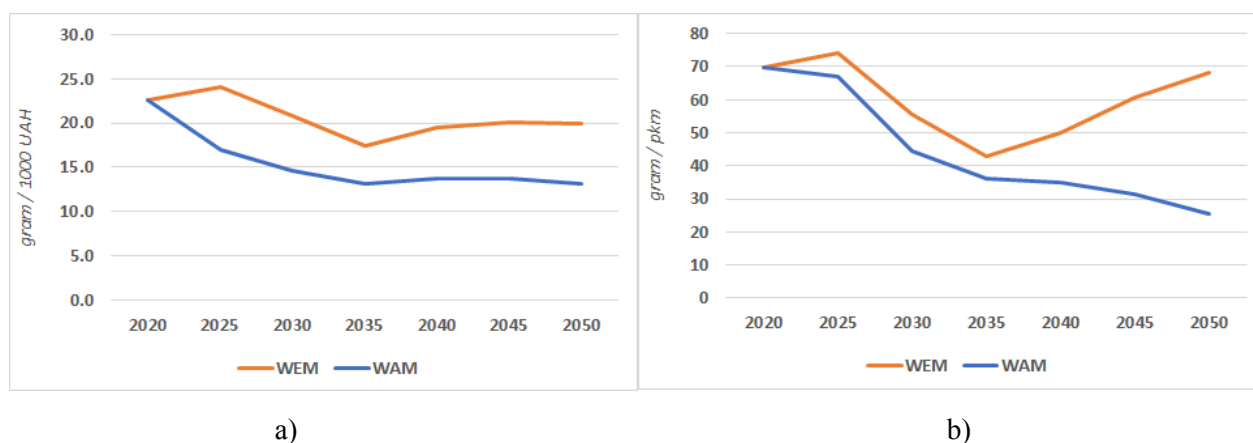
Figure 5.20. Specific energy consumption per 1 m² in the residential sector (Fig. 5.20a) and per 1000 UAH of added value in the service sector (Fig. 5.20b)



Source: calculations of the Institute of Economics and Forecasting of the National Academy of Sciences of Ukraine based on the TIMES-Ukraine model

Figure 5.21 shows the specific energy consumption per 1,000 UAH of added value in industry (Fig. 5.21a) and the specific energy consumption per passenger-kilometer (the number of passengers who traveled 1 km on average per year) (Fig. 5.21b).

Figure 5.21. Specific energy consumption per 1000 UAH of added value in industry (Fig. 5.21a) and passenger-kilometer in transport (Fig. 5.21b)

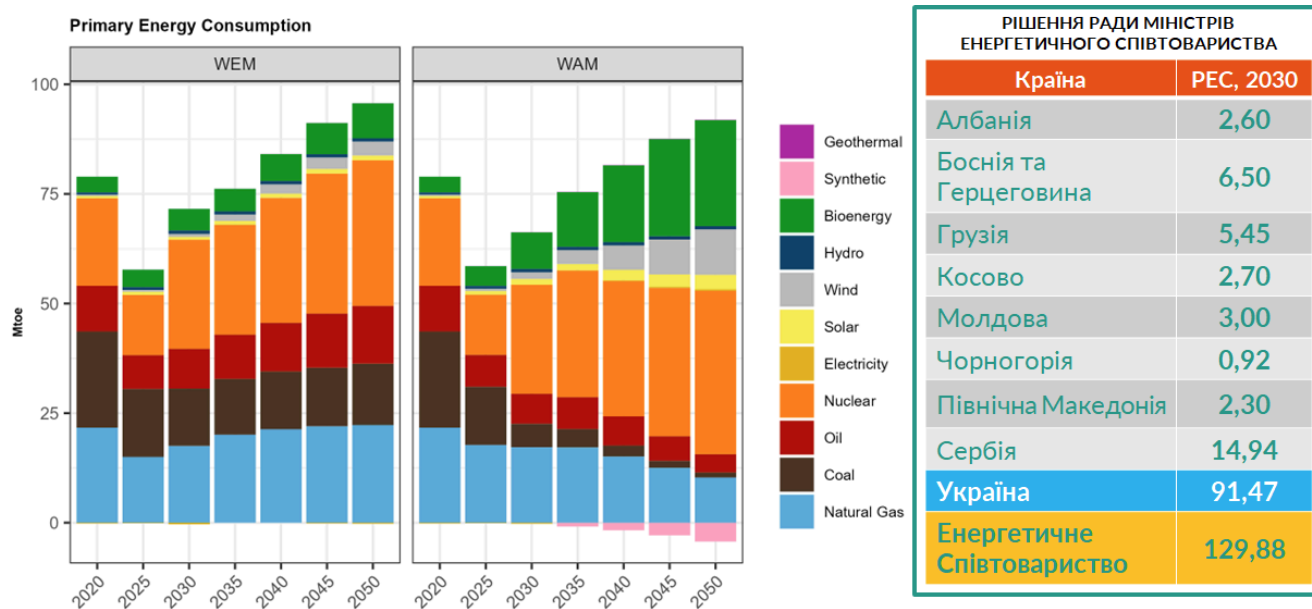


Source: calculations of the Institute of Economics and Forecasting of the National Academy of Sciences of Ukraine based on the TIMES-Ukraine model

iii. Assessment of interactions between existing policies and measures and planned policies and measures, and between those policies and measures and Energy Community climate and energy policy measure

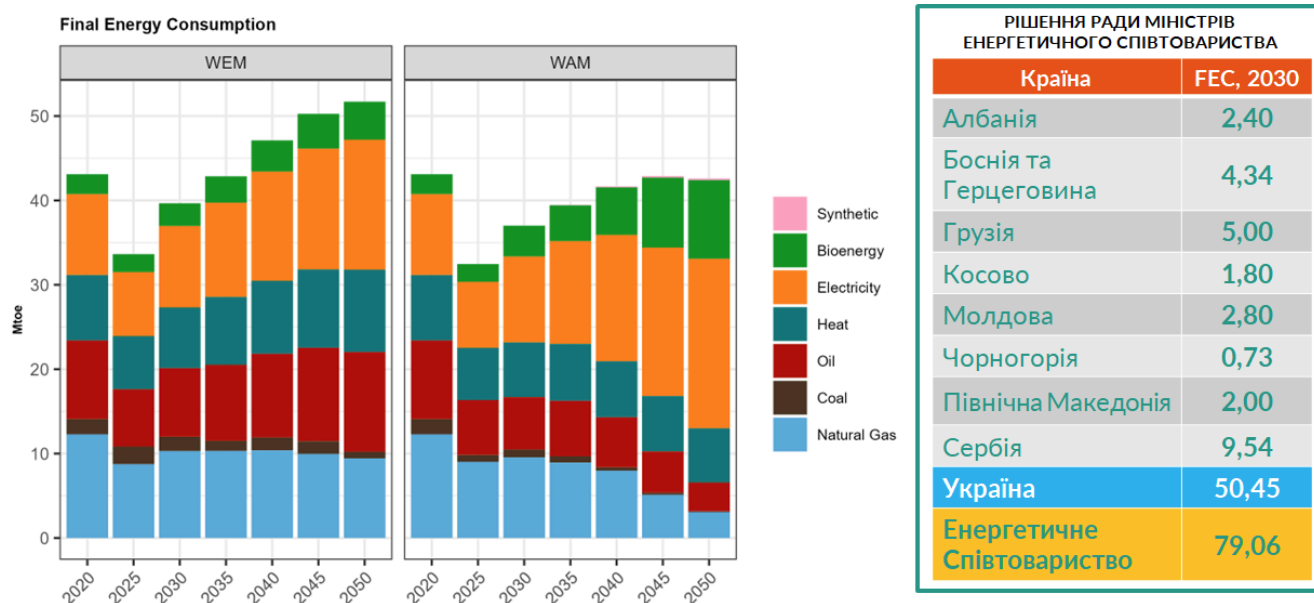
According to both WEM and WAM scenarios, indicators of primary and final energy consumption in Ukraine will not exceed the indicator for 2030, taken within the framework of the Energy Community (Figs. 5.22 and 5.23), and the share of RES in the structure of gross final energy consumption will be 27% (Fig. 5.24), which corresponds to the climate and energy policy of the Energy Community.

Figure 5.22. Primary energy consumption in Ukraine and target indicators for countries participating in the Energy Community, Mtoe



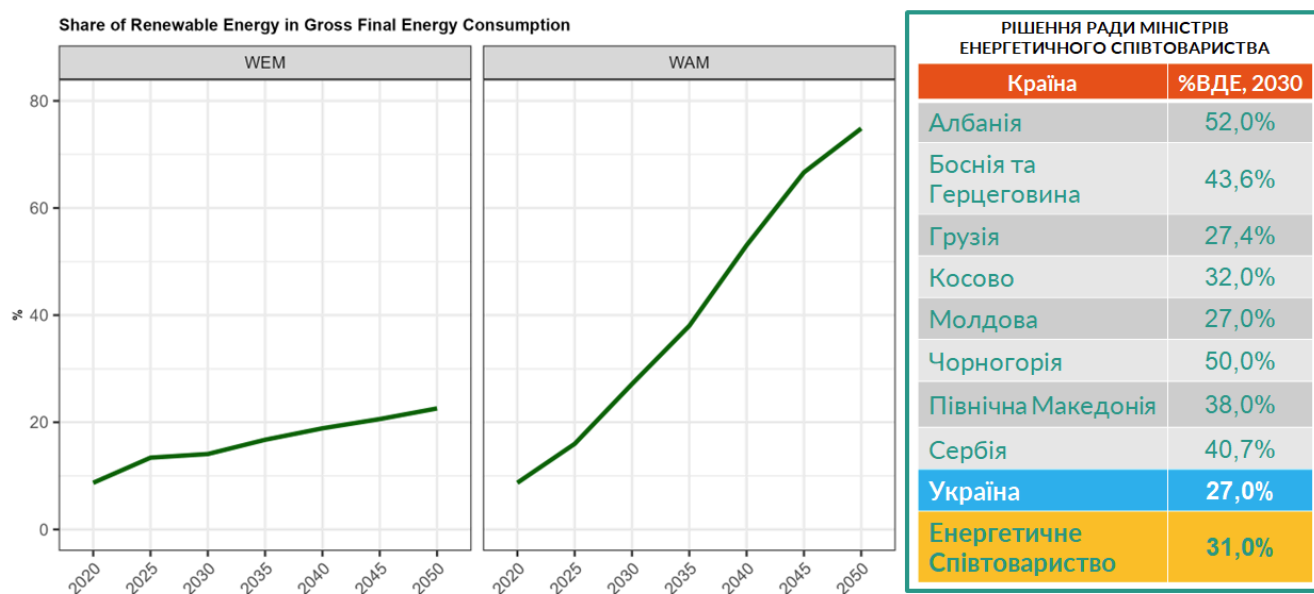
Source: calculations of the Institute of Economics and Forecasting of the National Academy of Sciences of Ukraine based on the TIMES-Ukraine model

Figure 5.23. Final energy consumption in Ukraine and target indicators for countries participating in the Energy Community, Mtoe



Source: calculations of the Institute of Economics and Forecasting of the National Academy of Sciences of Ukraine based on the TIMES-Ukraine model

Figure 5.24. The share of RES in the gross final energy consumption in Ukraine and target indicators for the countries participating in the Energy Community, %.



Source: calculations of the Institute of Economics and Forecasting of the National Academy of Sciences of Ukraine based on the TIMES-Ukraine model

5.2. Macroeconomic and, to the extent feasible, the health, environmental, employment and education, skills and social impacts, including just transition aspects (in terms of costs and benefits as well as cost-effectiveness) of the planned policies and measures described in section 3 at least until the last year of the period covered by the plan, including comparison to projections with existing policies and measures

At this stage, the assessment of the impact of the implementation of the scenarios with existing policies and measures (WEM) and planned policies and measures (WAM) on macroeconomic indicators was not carried out. However, an analogy can be drawn with the study of the macroeconomic impact of the implementation of the scenarios of the updated Nationally Determined Contribution of Ukraine to the Paris Agreement, which was carried out within the framework of the EBRD project "Support to the Government of Ukraine for the Update of the NDC"⁵⁰¹ and is described in detail in the IEP Modeling Report of the National Academy of Sciences of the Russian Academy of Sciences⁵⁰². According to this study, among the policy implementation options analyzed, the path of intensive investments in energy efficiency technologies is the most attractive both from the point of view of macroeconomics and from sectoral perspectives. In the case of implementation of such an option, there are significant benefits both for the economy and for the surrounding natural environment. With higher levels of investment and improvements in energy efficiency and relatively low prices for GHG emission reductions by 2035-2040, GDP will grow at a faster rate. At the same time, after 2035, due to a higher level of ambition to reduce GHG emissions and a corresponding increase in the carbon price, additional GDP growth rates will slow. Household incomes will be similar. The population will face a higher level of carbon prices, which will affect their purchasing power. At the same time, even during the period of 2040-2050, when the carbon price will exceed the level of 100 USD/ton of CO₂-eq., the population will still see an increase in the level of real incomes compared to the baseline scenario. Improvements in energy efficiency play a key role in making this happen, with significant reductions in the cost of production and correspondingly lower prices for end-users in households.

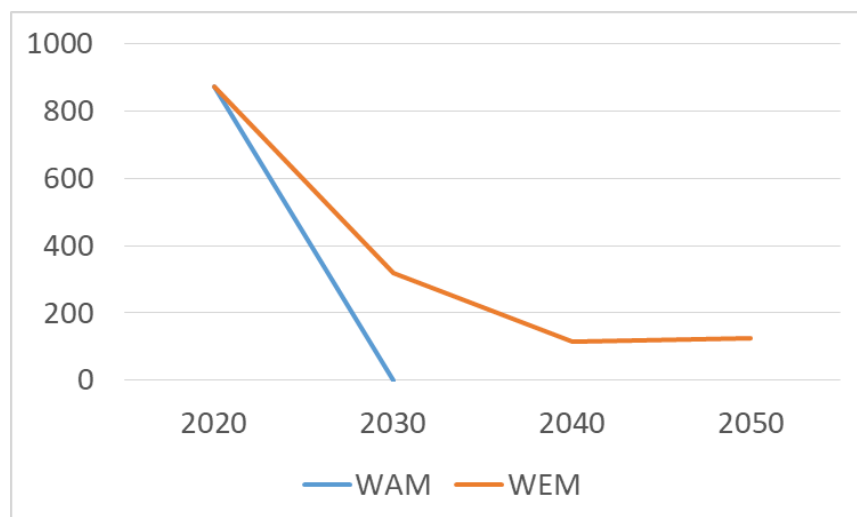
Also, with the implementation of ambitious energy and climate scenarios, significant transformations in the structure of production can be observed, which leads to significant reductions in GHG emissions and the energy intensity of GDP. This is particularly the case in scenarios with high carbon prices, such as coke and coal production/mining, which could fall by more than 75% in 2050. Other energy-intensive sectors such as metallurgical production, petrochemicals, utilities and metal processing can also significantly reduce their production. At the same time, there is a reorientation towards sectors that generate investments and relevant services. The latter include increased production in the programming and research sector. The construction sector is increasing production as a key supplier of the means of production of goods. The increase in the production of food products and the agricultural sector is mostly caused by the increase in the export of these goods.

Figure 5.25 illustrates reductions in pollutant emissions under the WEM and WAM scenarios. Due to the implementation of the NERP and the decommissioning of coal-fired power units of thermal power plants and thermal power plants, emissions of pollutants from large combustion plants disappear, which cannot fail to have a positive effect on the state of the natural environment and the health of the population, reducing the risks of diseases of the respiratory and circulatory system, reducing vulnerability to respiratory viral infections.

⁵⁰¹ <https://www.ebrd.com/ukraine-es-ukr.pdf>

⁵⁰² Dyachuk O.A., Podolets R., Chepelev M. and others. Modeling report of the EBRD Project "Support to the Government of Ukraine in updating the nationally determined contribution" [Electronic resource] // Ministry of Environment. – Available from: <https://menr.gov.ua/news/35316.html>

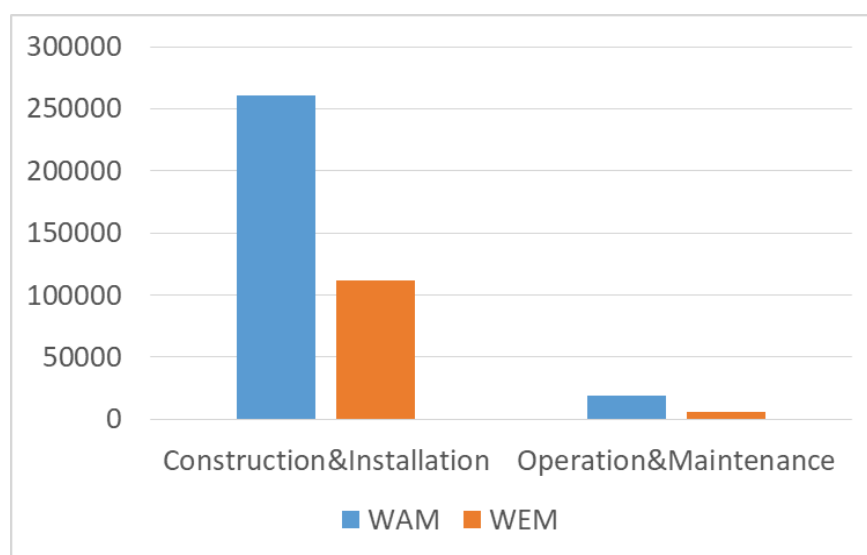
Figure 5.25. Total emissions of pollutants from large combustion plants, thousands of tons



Source: calculations of the Institute of Economics and Forecasting of the National Academy of Sciences of Ukraine based on the TIMES-Ukraine model

Using NREL data, the projected number of jobs (person-years) at new power plants was calculated, separately at the expense of construction and at the expense of maintenance (Fig. 5.26). The implementation of the WAM scenario allows to provide more than twice as many jobs. At the same time, 83% of jobs in construction and 87% in maintenance are related to RES.

Figure 5.26. Projected number of jobs created by construction and maintenance of new power plants in the WEM and WAM scenarios



Source: calculations of the Institute of Economics and Forecasting of the National Academy of Sciences of Ukraine based on the TIMES-Ukraine model

5.3. Overview of investment needs

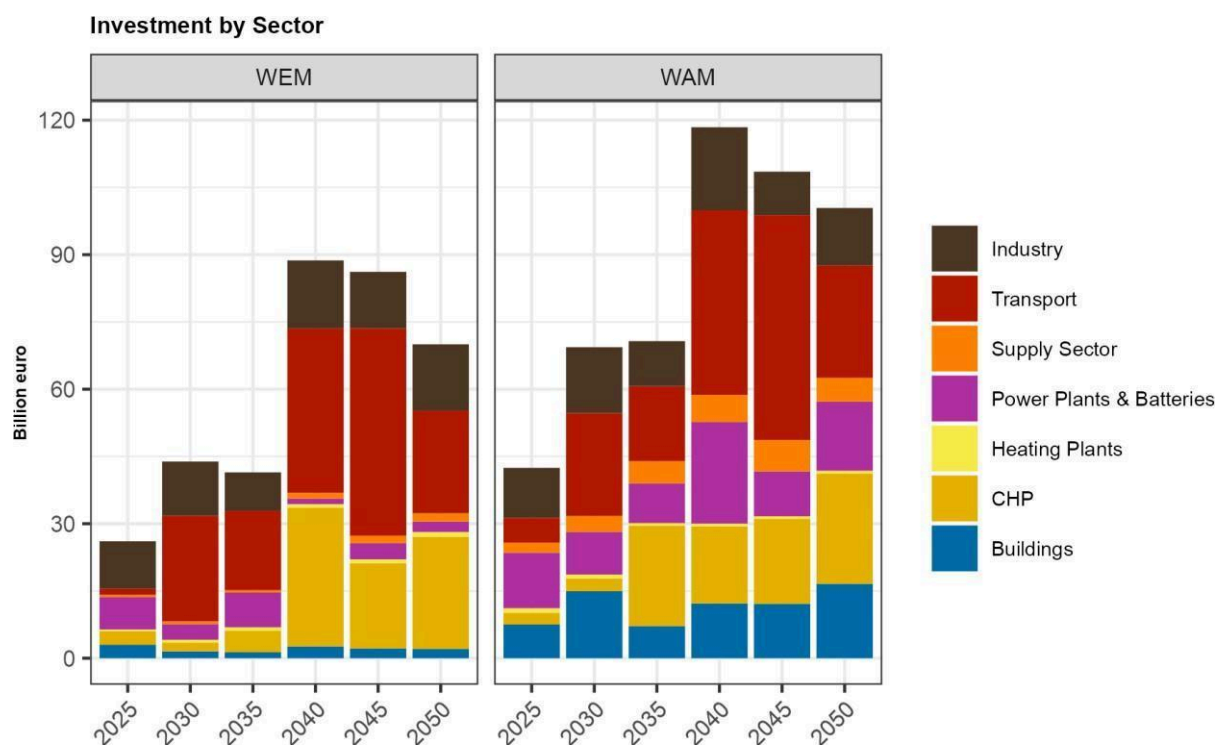
i. existing investment flows and forward investment assumptions with regard to the planned policies and measures

Investment needs in the "Energy" and "Industrial processes and product use" sectors

The overall investment needs are high in both scenarios, but fairly comparable. In both scenarios, the greatest investment needs are needed for the renewal and decarbonization (electrification) of the vehicle fleet (without taking into account the vehicles of households). Investments in electricity and heat

generation facilities are also significant, however, due to higher rates of thermal modernization of buildings, investment needs in cogeneration in the WAM scenario will be lower than in the WEM scenario. Also, investments in transport are larger as such, since the service life of transport technologies is less long and replacement is needed more often than for power plants and ESS. Note also that in the WEM scenario, investments are directed mostly to the replacement of existing equipment with the same, but new, while under the WAM, more investments are made in low-carbon technologies. The implementation of the WAM scenario requires 28% more investment, and the difference in total investment needs between the WEM and WAM scenarios is 169.8 billion EUR.

Fig. 5.27. Investment needs for the implementation of WEM and WAM scenarios in the "Energy" and "Industrial processes and product use" sectors



Source: calculations of the Institute of Economics and Forecasting of the National Academy of Sciences of Ukraine based on the TIMES-Ukraine model

Investment needs in the "Agriculture" sector

The investment needs for the gradual achievement of the projected volumes of greenhouse gas emissions in the "agriculture" sector according to the WAM scenario are shown in table 5.8 only for the policy on the dissemination of the use of information and electronic communication technologies in crop production. Estimates of investment needs for organic farming vary greatly because the prerequisites for implementing organic crop production in farms differ significantly. Therefore, they are not listed in the table below.

Table 5.8. Investment needs for the implementation of WAM scenario of the agricultural sector, million EUR

Policy	2030	2040	2050
Promoting the development of organic crop production	-	-	-
Disseminating the use of information and electronic communication technologies in crop production	400	600	2000

Note: Calculated on the basis of the assessment of investment needs for the "agriculture" sector in the report prepared as part of the project "Support to the Government of Ukraine regarding the update of the Nationally Determined Contribution", <https://mepr.gov.ua/wp-content/uploads/2023/07/Modeling-Report-3.pdf>.

Investment needs in the "Waste" sector

To implement the WEM scenario in the "Waste" sector, it is necessary to attract about EUR 1.04 billion of capital investments in the period from 2024 to 2030, inclusive. Overall, the implementation of the WEM scenario will require attracting about EUR 5.08 billion of capital investment in the waste management sector during 2024-2050.

To implement the WAM scenario, it is necessary to attract about EUR 2.02 billion in the period from 2024 to 2030 inclusive. In general, the implementation of the WAM scenario will require attracting about EUR 7.9 billion of capital investments. Tables 5.9 and 5.10 show the need for capital investments for the implementation of the WEM and WAM scenarios in cumulative sum during 2024-2050 and for separate periods, respectively.

Table 5.9. Capital investments for the implementation of the WEM and WAM scenarios cumulatively until 2050, in million EUR

	2025	2030	2035	2040	2045	2050
Waste management sector, cumulative total						
WEM	293.6	1039.3	2024.0	3027.3	4045.9	5075.6
WAM	569.8	2015.5	3488.2	4962.1	6433.4	7901.7

Table 5.10. Capital investments for the implementation of the WEM and WAM scenarios in separate periods until 2050, in million EUR

	2024-2025	2026-2030	2031-2035	2036-2040	2041-2045	2046-2050	That's all
Waste management sector, for the period							
WEM	293.6	745.8	984.6	1003.3	1018.7	1029.6	5075.6
WAM	569.8	1445.8	1472.7	1473.8	1471.3	1468.4	7901.7

ii. sector or market risk factors or barriers in the national or regional context

Lack of funding for existing and planned policies . Planned tax revenues for 2024 in accordance with the Law of Ukraine "On the State Budget of Ukraine for 2024" amount to UAH 1.57 trillion. At the same time, spending on the defense sector amounts to UAH 1.69 trillion. In such conditions, the Government is forced to cut other expenses, e.g. on the implementation of energy-efficient measures.

Thus, no funds are provided for financing the activities of the Energy Efficiency Fund in 2024. At the same time, the implementation of the State targeted economic program to support the thermal modernisation of buildings until 2030 requires financing in the amount of UAH 172.91 billion to UAH 934.25 billion for the entire period of validity. Implementation of the State Targeted Economic Program for the Energy Modernisation of State- or Communal-Owned Heat Producers for the period up to 2030 from UAH 168.7 billion to UAH 632.7 billion. In the current conditions, there is a high risk that the policies and measures of NECP, in particular according to the "Energy efficiency" dimension, will not be financed or financed to an incomplete extent.

Lack of demand among the population. The decisive factor that will contribute to the implementation of reforms and energy-efficient measures by the population is the introduction of market prices for energy. Currently, electricity tariffs for the population are set administratively, prices for natural gas and thermal energy are also regulated and fixed not higher than the corresponding levels on February 24, 2022 during the period of martial law in Ukraine and six months after its cancellation. However, the Government has limited opportunities to liberalize prices in view of the drop in incomes of the population due to the full-scale invasion of the Russian Federation in Ukraine: according to the results of 2022, real wages have decreased by 11.4%. At the same time, there are still risks of damage or destruction of buildings throughout the territory of Ukraine, which also contributes to the postponement of the demand for the implementation of energy-efficient measures for the post-war period.

Lack of qualified personnel. The need for reconstruction based on the "Build Back Better" principle, the implementation of energy efficiency improvement policies (local energy plans, implementation of energy management systems), the development of new production chains in the climate innovation and renewable energy sectors increase the demand for qualified personnel. At the same time, the mobilization to the Armed Forces of Ukraine, as well as the departure of a significant number of the population outside of Ukraine as a result of the full-scale invasion of the Russian Federation into Ukraine, are already creating a shortage of workers who could improve their qualifications or acquire a new specialty.

iii. analysis of additional public finance support or resources to fill identified gaps identified under point ii

Possibilities of additional support from the State Budget of Ukraine are extremely limited. During the period of martial law, the directions of the state budget policy are focused on the redistribution of state budget funds in order to support the key needs of the Armed Forces of Ukraine, ensure the country's defense capability, and implement measures to ensure national security. Thus, there is a lack of funds even to finance existing economic programs. Clause 12 of the Measures regarding the effective and rational use of state funds, provided for the maintenance of state authorities and other state institutions, enterprises, institutions and organizations established by state authorities, which use state budget funds, approved by the Resolution of the Cabinet of Ministers of Ukraine of October 11, 2016 No. 710 "On the Effective Use of State Funds" (Official Gazette of Ukraine, 2016, No. 83, Article 2739; 2019, No. 47, Article 1608, No. 94, Article 3098; 2022, No. 10, Article 531; 2024, Article 2687) provides for the suspension of the preparation of new state programs or the introduction of changes to the approved state budget. The condition for the inclusion of exceptions to the Measures is the provision in new programs of financing from the state budget starting from the second budget period after the abolition of martial law in Ukraine.

Budgetary financing of state targeted economic programs can be considered at the expense of grants for budget support from foreign countries, foreign financial institutions and international financial organizations (including grants for achieving performance indicators), income from assistance programs and grants of the European Union, governments of foreign countries, international organizations, donor institutions, as well as credits (loans) received by the state from foreign countries, foreign financial institutions and international financial organizations for the implementation of investment projects. At the same time, in accordance with the requirements of the legislation, the implementation of state borrowing and management of the state debt, the provision of state guarantees is carried out under a number of

conditions and is limited - especially in circumstances when Ukraine does not have full access to the international borrowing market and has a limited resource of the domestic market.

Similarly, the resources of local budgets are also quite limited, and their availability depends on a number of factors - economic activity in the territory of the relevant territorial community, financial capacity of the local government, etc. Local borrowing and local debt management, provision of local guarantees are also subject to a number of conditions and limitations.

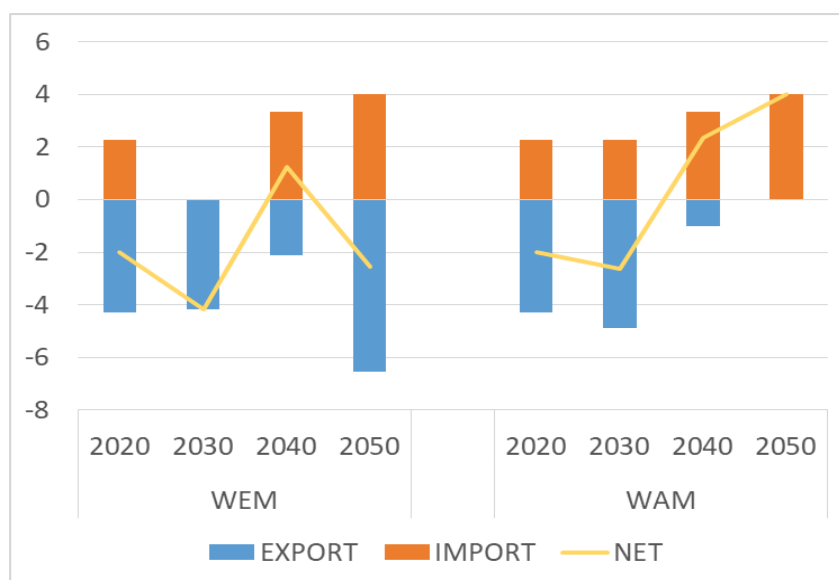
Thus, support must come from other sources not prohibited by law. These are, in particular, investors' funds (due to the introduction of market mechanisms to stimulate them, simplification of permitting procedures, other non-fiscal forms of support), grant programs, other available financial instruments (e.g., syndicated loans guaranteed by foreign states, foreign financial institutions, and international financial organizations, bonds issued by them, other forms of mixed financing), especially of a targeted nature (e.g., climate financing). Among the sources of such financing and/or provision of guarantees are also considered the funds received at the expense of the seized assets of the Russian Federation, and potentially the assets of the Russian Federation themselves, seized in the jurisdictions of Ukraine's allied states.

5.4. Impacts of planned policies and measures described in section 3 on other Contracting Parties and/or Member States of the European Union and regional cooperation at least until the last year of the period covered by the plan, including comparison to projections with existing policies and measures

i. Impacts on the energy system in neighbouring and other Contracting Parties and/or Member States of the European Union in the region to the extent possible

Figure 5.28. demonstrates that under the WAM scenario, the UES will become a net importer of electricity, whereas, under the WEM scenario, the Ukrainian energy system will be able to export electricity to neighboring countries due to lower domestic demand for electricity, which, however, arises from the lack of effective decarbonization measures in the energy consumption sectors, which, in turn, are often based on the electrification of equipment.

Fig. 5.28. Import-export of electricity from UES of Ukraine to neighboring countries

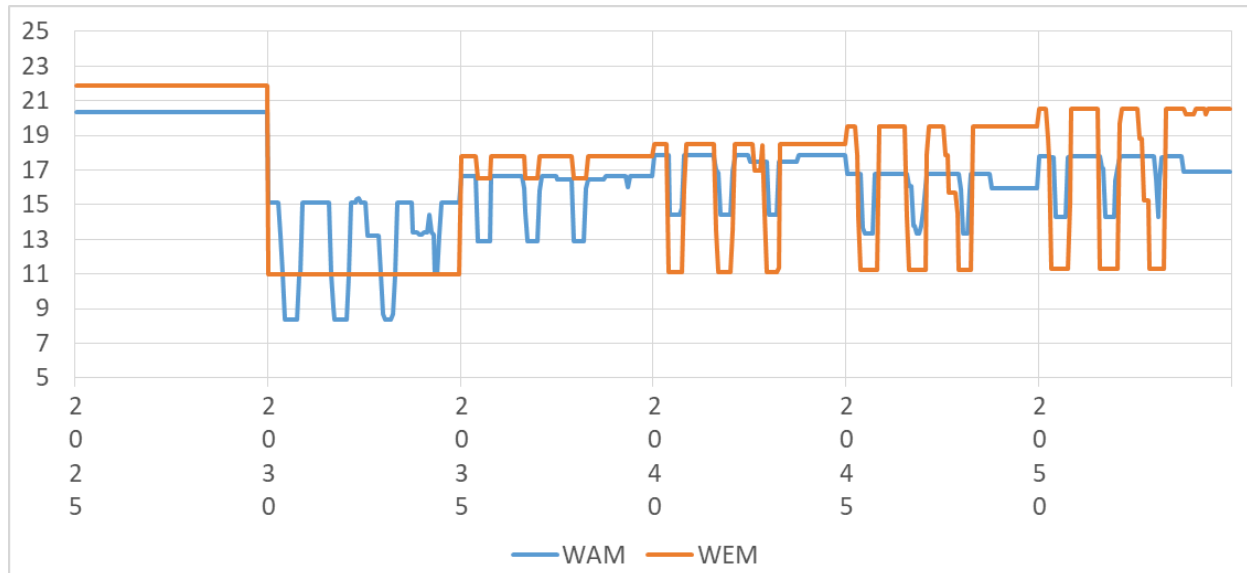


ii. Impacts on energy prices, utilities and energy market integration

Electricity market

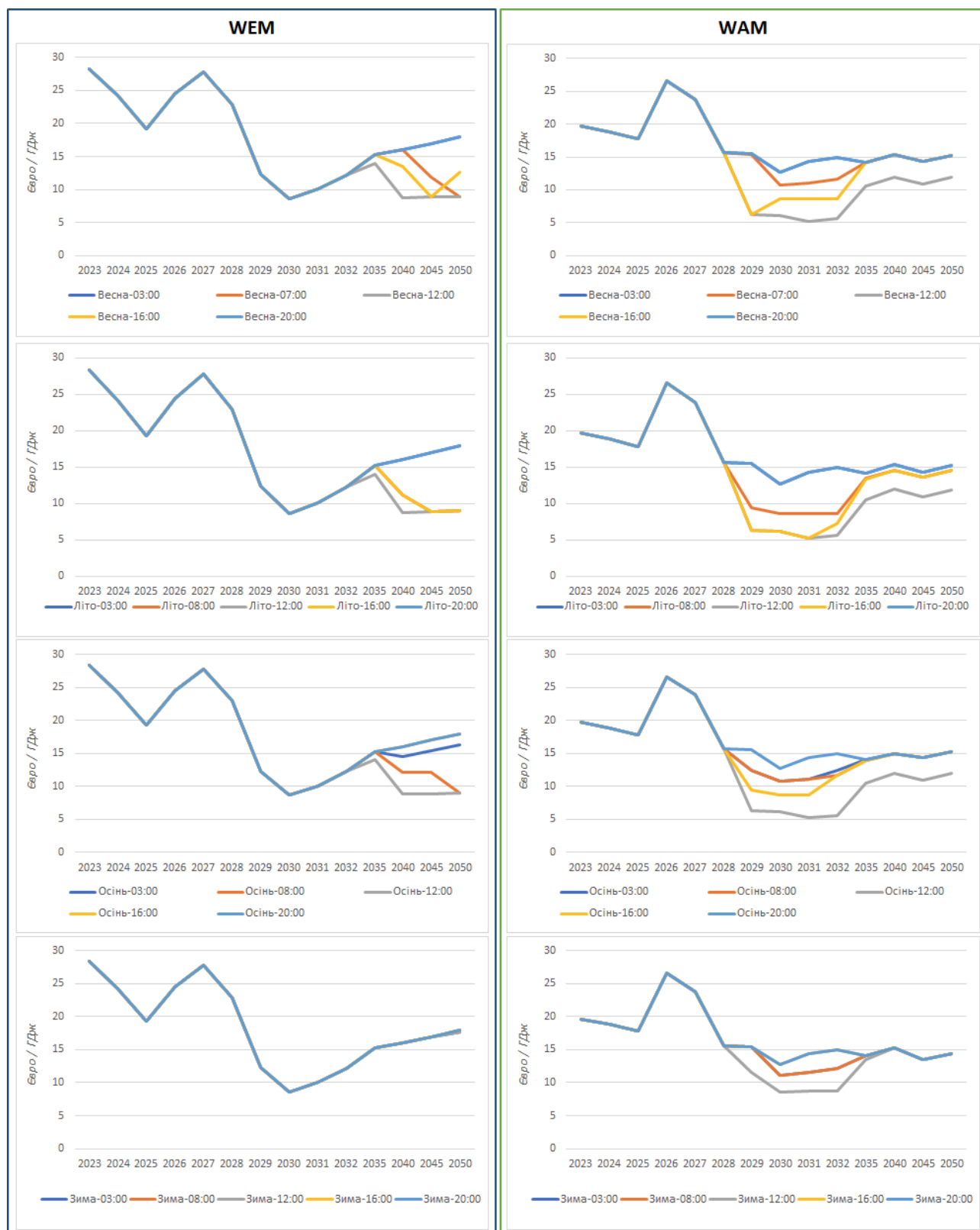
It is expected that the impact of the planned policies and measures (WAM scenario, Fig. 5.29) on energy prices will be quite significant when the specified scenario is fully implemented. In particular, simulation results using the TIMES-Ukraine model show that average marginal electricity prices may vary little, but volatility in the WEM scenario is projected to be greater than in the WAM scenario.

Fig. 5.29. The marginal price for electricity according to the WEM and WAM scenarios, Euro/GJ



The forecast of marginal prices in selected hours by year for the spring, summer, autumn and winter periods is shown by Figure 5.30, showing the advantages of developing renewable electricity, especially wind and solar compared to coal generation, even in winter.

Fig. 5.30. Marginal electricity prices in selected hours in four seasons of the year under WEM and WAM scenarios, EUR/GJ



Gas market

Planned policies and measures will ensure conditions for cross-border movement of gas (natural gas, biomethane) across Ukraine's border with EU and Energy Community Contracting Parties. These are measures to remove bans on exports from Ukraine, create a system of guarantees of origin and proofs of sustainability, etc. At the same time, ensuring the unhindered movement of these goods from Ukraine to

the EU and taking into account their real value, including green components, will be possible only if the necessary measures are taken by the EU and EU member states.

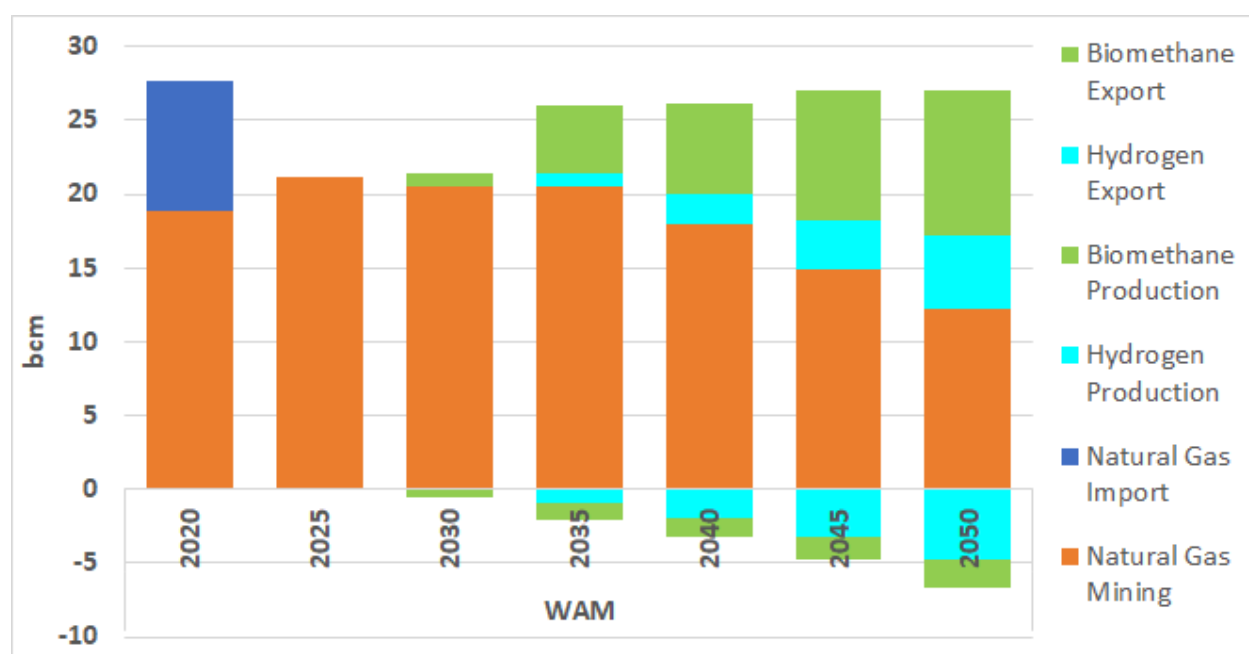
With the opening of gas exports to the EU, it can be expected that some part of domestic production may be exported. This can be positive in terms of foreign exchange earnings and overall business integration, but can carry risks in terms of the need to purchase the required volumes of the resource from abroad (i.e. security of supply and purchase price issues). Accordingly, comfortable conditions should be created on the domestic market for the sale of domestically produced gas. To this end, the planned measures include, on the one hand, the liberalization of gas prices (simultaneously with the renewal of the system of housing subsidies, the creation of a system for the protection of vulnerable consumers and the monitoring and reduction of energy poverty), and on the other hand, the improvement of the conditions of access of sellers to the functioning wholesale market and to retail market (improvement of the rules of commercial accounting, balancing, reforms of GDS).

In addition, the planned policies and measures will enable the existing energy infrastructure to adapt to new conditions, with an emphasis on deeper integration into political, research, design and business processes in the EU. This, in turn, will make it possible to reduce the burden of costs for the creation and transformation of infrastructure on Ukrainian consumers, as well as increase income from foreign buyers of services of energy infrastructure facilities.

According to the results of modeling using the TIMES-Ukraine model, natural gas production for domestic consumption may be sufficient at the level of 19-20 bcm, after which, with more intensive implementation of decarbonization measures, in particular a significant increase in the price of CO₂ and expansion of the production of renewable gases (primarily biomethane), gas production will decrease to 11.4 bcm in 2050 (Fig. 5.31). The marginal price for natural gas under the WAM scenarios may be lower than the corresponding price in the WEM scenario since the demand for natural gas will be lower in the WAM scenario (Fig. 5.32).

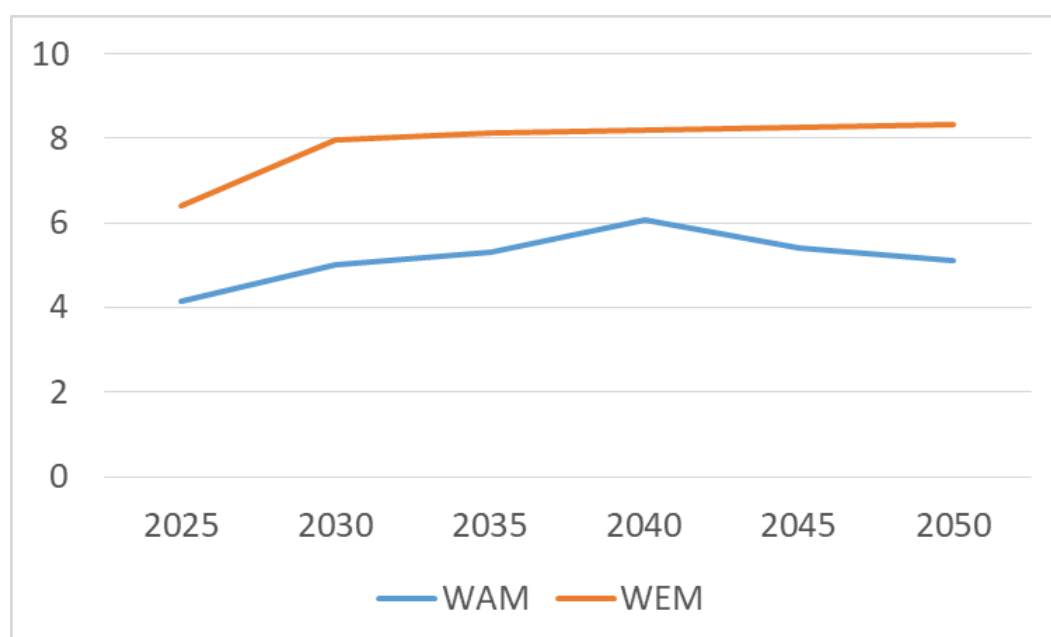
At the same time, biomethane production will increase from 0.9 bcm in 2030 to almost 10 bcm in 2050 and will mainly be consumed in the domestic market, reaching exports of 1.9 bcm in 2050. Instead hydrogen production may reach 1.0 bcm in 2035 and grow to 5.0 bcm, but unlike biomethane, almost all of it will be exported to EU countries.

Fig. 5.31. Production and import of natural gas, production and export of biomethane and hydrogen, bcm



Source: calculations of the Institute of Economics and Forecasting of the National Academy of Sciences of Ukraine based on the TIMES-Ukraine model

Fig. 5.32. Marginal price for natural gas under WEM and WAM scenarios, EUR/GJ

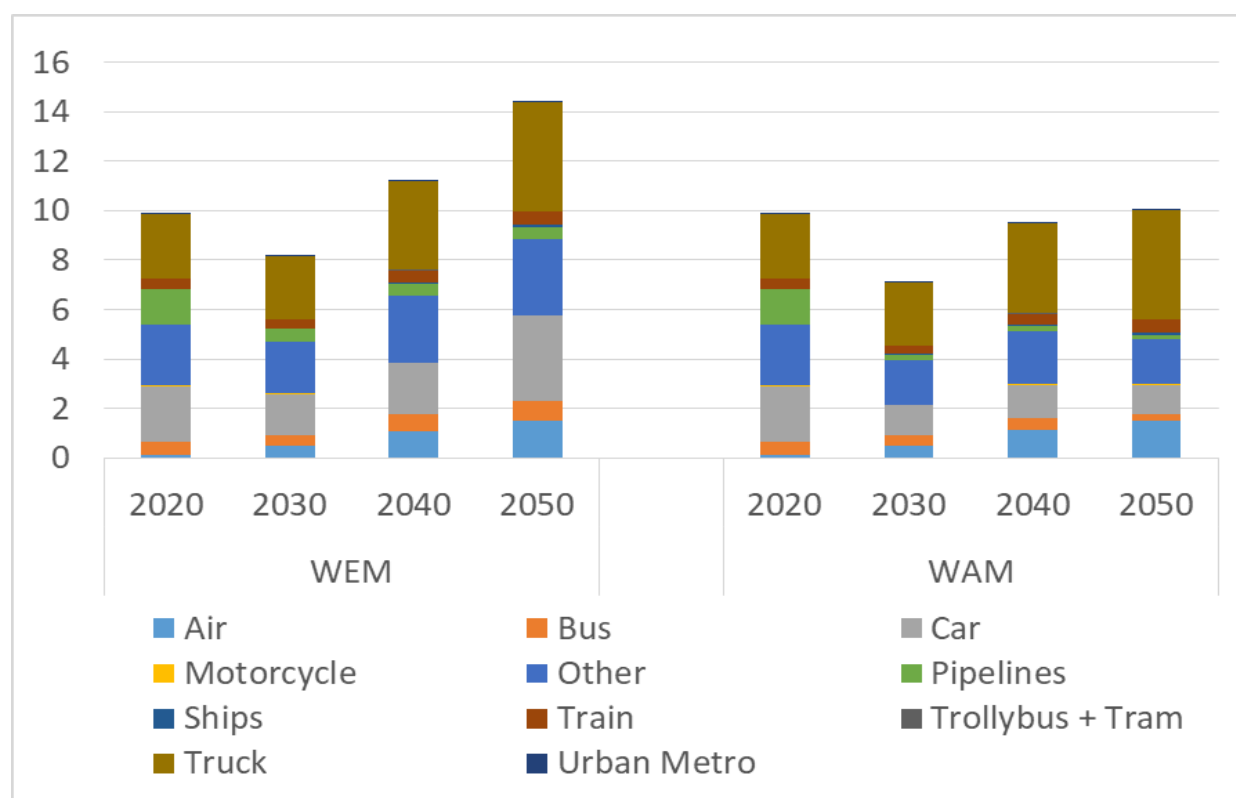


Source: calculations of the Institute of Economics and Forecasting of the National Academy of Sciences of Ukraine based on the TIMES-Ukraine model

Energy use in transport

Freight transportation by road transport is the most energy-intensive form of transport under both scenarios. The WAM scenario, however, manages to decarbonize this type of transport somewhat at the end of the simulation horizon with biomethane, bioethanol and biopropane.

Fig. 5.33. Energy use in transport by types of transport, Mtoe



Source: calculations of the Institute of Economics and Forecasting of the National Academy of Sciences of Ukraine based on the TIMES-Ukraine model

iii. Where relevant, impacts on regional cooperation

Liberalization and integration of energy markets, revitalization of trade in products (both energy resources and derived decarbonized industrial products) and services between Ukraine, on the one hand, and EU member states and Contracting Parties of the Energy Community, on the other hand, will require a fundamentally higher level of interaction. The realization of the export potential of Ukraine's economy will depend not only on the market situation (price signals, market structure and concentration), but above all on the pace of implementation of reforms on the way to EU membership and the corresponding removal of obstacles in interstate trade.

At the same time, such enhanced cooperation should take place at different levels (between Ukraine and the institutions of the EU and the Energy Community, intergovernmental, between network and infrastructure operators, between local authorities and local governments, at the level of business and other business relations) and cover the entire spectrum potential issues - from joint assessment of risks, planning of infrastructure development, to the development of harmonized policies, standards, approaches, implementation of joint investment projects. Regional initiatives such as P-TECC, CESEC, SEEGAS, European Hydrogen Backbone, etc. will play an increasingly important role.

As part of Ukraine's accession to the EU, part of the decisions will be made at the supranational level, within the framework of pan-European policies and/or mechanisms, which will be an advantage for Ukraine in those issues where neighboring states do not show a counter initiative or mutual interest. A significant success factor will be the speed of Ukraine joining European platforms, information exchange platforms, databases (both those regulated by EU acts and voluntary ones), cluster organizations. An additional opportunity for the development of cooperation is the industrial alliances supported by the European Commission in new chains of added value creation (hydrogen, renewable and low-carbon fuels, critical raw materials, batteries, circular plastic, semiconductors, other fields of advanced and low-carbon technologies).

Appendix 1 to the Plan

The methodological basis for the formation of modeling scenarios in accordance with Regulation (EU) 2018/1999 (hereinafter - the Regulation) and taking into account the peculiarities of public administration in Ukraine

For the purposes of NECP, modeling is carried out according to two mandatory scenarios:

- 1) with existing policies and measures (WEM); ⁵⁰³
- 2) with planned policies and measures (WAM). ⁵⁰⁴

At the same time, the existing policies and measures include: ⁵⁰⁵

- a) implemented policies and measures (implemented policies and measures);
- b) adopted policies and measures.

Regulations separately define what is meant by "implemented", "adopted" and "planned" policies and measures. It is useful to consider these definitions in English and Ukrainian:

Regulation 2018/1999 ⁵⁰⁶	Regulation 2018/1999 (translation available on the website of the Verkhovna Rada of Ukraine ⁵⁰⁷)
"implemented policies and measures" means policies and measures for which one or more of the following applies at the date of submission of the integrated national energy and climate plan or of the integrated national energy and climate progress report: directly applicable Union or national law is in force, one or more voluntary agreements have been established, financial resources have been allocated, human resources have been mobilized;	"implemented policies and measures" means policies and measures to which, as of the date of submission of the integrated national energy and climate plan or the integrated national energy and climate progress report, one or more of the following conditions apply: there is an existing Union or national law, which is subject to direct application, one or more voluntary agreements have been concluded, financial resources have been allocated, human resources have been mobilized; ⁵⁰⁸
'adopted policies and measures' means policies and measures for which an official government decision has been made by the date of submission of the integrated national energy and climate plan or of the integrated national energy and climate progress report and there is a clear commitment to proceed with implementation;	"adopted policies and measures" means policies and measures for which, as of the date of submission of the integrated national energy and climate plan or the integrated national energy and climate progress report, a formal government decision has been made and there is a clear commitment to further implementation; ⁵⁰⁹
"planned policies and measures" means options that are under discussion and that have a realistic chance of being adopted and implemented after the date of	"planned policies and measures" means options, which are at the stage of discussion and have a real chance of being adopted and implemented

⁵⁰³ Regulation, Article 8(1).

⁵⁰⁴ Regulation, Article 8(2).

⁵⁰⁵ Regulation, Article 2(2).

⁵⁰⁶ <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02018R1999-20230516>

⁵⁰⁷ https://zakon.rada.gov.ua/laws/show/984_030-18#Text

⁵⁰⁸ Regulation, Article 2(3).

⁵⁰⁹ Regulation, Article 2(4).

Continuation of Appendix 1 to the Plan

submission of the integrated national energy and climate plan or of the integrated national energy and climate progress report;	after the date of submission of the integrated national energy and climate plan or the integrated national energy and climate progress report; ⁵¹⁰

These definitions shall be applied subject to the following.

First, given that integrated national progress reports on energy and climate are developed and approved on the basis of the adopted NECP,⁵¹¹ and that Ukraine's first NECP is currently being prepared, for the purposes of qualifying measures according to the above definitions, it will be the estimated date of submission of the NECP should be used. At the same time, based on the terminology of the English version of the Regulation, it refers to the submission of the draft or final version of the NECP to the European Commission, and in the case of Ukraine, to the Secretariat of the Energy Community.

Second, the phrase "applicable Union [Energy Community] law or directly applicable national law" must be interpreted taking into account what EU law understands by directly applicable rules.⁵¹² Norms of direct application are norms that can be the legal basis for the claims of individuals and legal entities regarding the recognition of their rights both to the state (vertical direct application) and to other persons (horizontal direct application). The norm of direct application can be contained in a law, a by-law, as well as (in some cases) an international treaty. However, not every norm of the law, by-law or international treaty is a norm of direct application. The norm has direct application if it is specific, clear and unconditional, as well as if it does not require additional implementation measures from the state. The status of a norm of direct application is determined by analyzing a specific norm on the basis of the specified criteria. In the context of Ukraine, an example of a norm of direct application can be the provision of the law on the effect of the principle of non-discrimination in relations between subjects of energy markets. Norms of direct application are not norms that determine the goals or general tasks of the state, its bodies or other persons, define a wide range of discretion in their application or require additional implementation actions.

Thirdly, given the relatively small number of norms of direct application in the energy legislation of Ukraine, as well as the legal uncertainty regarding the direct application of norms from the acts of the Energy Community, the implemented policies and measures will primarily include policies and measures regarding which:

- a) "one or more voluntary agreements have been concluded" (that is, the policy or measure is implemented not in pursuance of a legal norm, but of a concluded agreement that must be implemented), or
- b) "allocated financial resources" (i.e., relevant costs included in the tariff of regulated market entities, allocated from the state budget or from funds of international financial assistance, etc.), or
- c) mobilized human resources.

With regard to concluded agreements, the agreements themselves are taken into account, and not memoranda of understanding or letters of intent.

⁵¹⁰ Regulation, Article 2(5).

⁵¹¹ Regulation, Article 17(1).

⁵¹² <https://eur-lex.europa.eu/EN/legal-content/summary/the-direct-effect-of-european-union-law.html>

Continuation of Appendix 1 to the Plan

With regard to the allocation of financial resources, the presence of an approved, sufficiently clear financing mechanism for relevant policies or measures is taken into account, which can be the basis for the formation of legal requirements of the parties (for example, the funds are included in the tariff, the right to conclude a purchase and sale agreement at the green tariff / tax discount / a reduced tax rate determined by legislation, and there are no regulatory restrictions for its implementation, etc.). Problems with the application of such mechanisms (for example, non-payment by parties, accumulation of debts, etc.) can be taken into account for the recognition of the status of policies and measures only in exceptional cases.

The implemented policies and measures are closely related to the adopted policies and measures as they are combined within a single set of existing policies and measures. The criteria for adopted policies and measures are: a) "an official government decision has been adopted" and b) "there is a clear commitment to further implementation."

Given that the executive branch of government usually adopts specific policies and measures, and the Government is its representative, the reference to the existence of a government decision does not mean a restriction on the decision-making body (ie, not only the Government can make such a decision), but rather indicates to the specificity and realism of policies and measures belonging to the group of adopted and, accordingly, existing policies and measures. At the same time, the adoption of a norm by the parliament on its own initiative (in the absence of the Government's initiative) can be an indicator that the policy or measure cannot be related to the adopted and existing ones, in particular, in the case of non-fulfillment of the second criterion.

The criterion of having a "clear commitment to further implementation" is interpreted as follows: if there is a legal basis for the relevant policy and measure, the necessary actions and resources are clearly defined for its implementation, and there is an understanding that these resources should be allocated. The close connection with implemented policies and measures indicates that in the case of adopted policies and measures, it is precisely a clear commitment to allocate financial resources, mobilize human resources, or be ready to enter into voluntary agreements.

Fourth, it should be noted that planned policies and measures refer to 'options' (not 'policies and measures' as in the previous definitions).

Two criteria are put forward for these options: a) being at the discussion stage; and b) "a real chance of being adopted and implemented after the date of submission." Considering the terminology of the English version, discussions do not mean formal public discussions, but mostly the presence of a discussion of the relevant option in public circles. The existence of a discussion is presumed if it is about policies and measures that are planned in response to an already adopted act of higher legal force (law).

The second criterion is restrictive in terms of the range of all possible options under discussion. In this case, several cases are accepted, which indicate the realism ("real chance") of the options. The first case is the option announcement level: it is taken into account that policies and measures can be considered realistic under the condition of official announcement by such state officials as the President, Prime Minister, Deputy Prime Minister, Minister, Head or Deputy Heads of the Office President, under the conditions of their sufficient detail and objective realism. The second case is the presence of specific external factors that clearly encourage the implementation of policies and measures. These external factors can be both part of Ukraine's international obligations and contained in the legislation of other countries. To identify such external factors, it is not enough that they are part of Ukraine's international obligations. In addition to formal obligation, the factor of high risk of sanctions or other negative consequences from non-fulfillment of obligations or other third-party conditions (for example, non-provision of funds, refusal to purchase products, etc.) should be added. Examples of the second case can be CBAM, EU requirements for green hydrogen, sustainability of biofuels, etc.

Continuation of Appendix 1 to the Plan

Fifth, given that the planned policies and measures are options, several such options can be used during simulation, forming several scenarios with planned measures. At the same time, Chapter 5 of the NECP should describe the macroeconomic impact, if possible - the impact from the point of view of health care, the environment, labor requirements and social impact, the ability to attract financing for implementation, as well as the significance from the point of view of achievement the principle of climate neutrality of the planned policies and measures or their groups, which will enable a proper and comprehensive analysis of such options.

It should be noted that policies / measures are policies / measures adopted at the state level. Policies / measures at the level of companies, including state ones, for the purposes of the first NECP of Ukraine are not distinguished as separate policies / measures but are adopted to determine the degree of achievement of goals from state policies / measures.

The TIMES-Ukraine model, developed in the IEP of the National Academy of Sciences of the National Academy of Sciences, is used for the simulation of NECP scenarios, improved and updated to the latest software in July 2023 thanks to the global initiative Net Zero World⁵¹³. The applicable model covers the "Energy" and "Industrial processes and product use" sectors (as defined by the Intergovernmental Panel on Climate Change, IPCC). Other model tools will be used for the remaining sectors ("Agriculture", "Waste", "Waste").

Modeling for the purposes of NECP takes place in order to assess the extent to which existing and planned policies and measures enable the achievement of the goals defined at the level of the EU or the Energy Community. At the same time, due to the lack of time for the preparation of the first NECP of Ukraine, the impact of individual existing and planned measures is not investigated, but the assumption is taken into account that those measures, which are defined as existing or planned, are realistic and effective enough to achieve, in a full or expertly determined degree, the impact envisaged for them by the developers. Modeling for NECP goals differs from other approaches, such as modeling by goals, in which a particular goal is set as an assumption and the goal of the modeling is to determine the optimal path to achieve a fixed goal.

The modeling process for the purposes of NECP consists of several stages:

- 1) formation of a number of assumptions common to all NECP scenarios, in particular regarding the main macroeconomic indicators, the future demographic situation, prices on foreign markets, the cost of technologies, areas of residential and non-residential premises, minimum or limit values of individual energy indicators;
- 2) distribution of all policies and measures described in the NECP between scenarios, as well as into scenario parameters and indicators; the main criteria for the allocation between parameters and indicators
 - a) the parameters have a higher probability of impact, which can be included in the NECP;
 - b) parameters do not compete with other policies and measures within the same scenario;
- 3) formation of scenarios as a combination of assumptions and selected parameters;
- 4) obtaining the first simulation results;
- 5) review of the first modeling results by experts, as well as their discussion through technical consultations or public discussions with various interested parties;
- 6) taking into account the results of the discussions and expert assessment, and adjusting the scenarios and, if necessary, the goals, policies and measures for re-simulation and updating the descriptive part of the NECP.

⁵¹³ <https://www.nrel.gov/international/net-zero-world.html>

GHG emissions in agriculture and assumptions about the main parameters of agricultural development

In agriculture, the emissions of three greenhouse gasses (methane (CH₄), nitrogen (I) oxide (N₂O) and carbon (IV) oxide (CO₂)) are considered, the emissions of which are a result of an economic activity in two sectors - livestock and crop production.

Animal husbandry is characterized by two processes, which are accompanied by the emission of mainly methane and, in a relatively small amount, nitrogen (I) oxide: intestinal (or enteral) fermentation of agricultural animals (mainly cattle); handling of droppings and manure of farm animals.

Crop production has a much more complex organization and is characterized by the emission of all three greenhouse gasses in the following processes:

- N₂O: application of nitrogen (mineral) fertilizers; application of organic fertilizers; application of organic fertilizers from livestock grazing; introduction of nitrogen (N) with crops residues; mineralization or immobilization of nitrogen (N) associated with the movement of organic matter in the soil; cultivation of organic soils; weathering of nitrogen (N); leaching of nitrogen (N);
- CH₄: rice cultivation;
- CO₂: application of urea; liming of soils.

The key factors that determine the dynamics of greenhouse gas emissions in animal husbandry are the number of farm animals and the manure management system, which is used to collect, transport, store and use manure. The manure management system as a separate factor that regulates the amount of greenhouse gas emissions both by the amount of manure entering it and by the type of system in which this manure is collected, transported, stored and used. The following types of manure management systems are mainly used in the livestock industry of Ukraine: solid storage system; liquid manure storage system; storage system in open anaerobic lagoons; aerobic treatment system; composting; manure/excrement left on pasture, paddocks, etc.

The field of crop production in agriculture is multifaceted, and therefore it is impossible to single out general key factors that would determine the dynamics of greenhouse gas emissions in all or most processes - only special ones, namely:

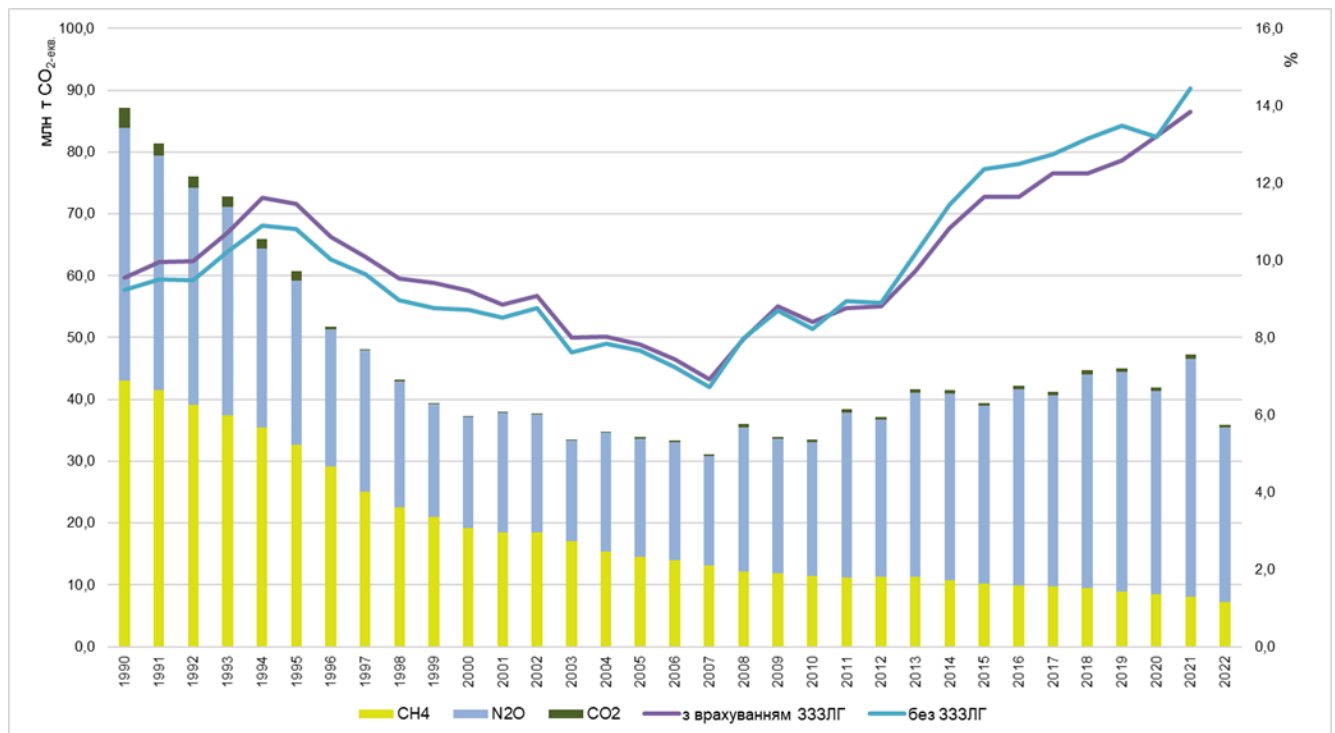
application of nitrogen (mineral) fertilizers	– amount of nitrogen (mineral) fertilizers applied to arable soils;
application of organic fertilizers	– amount of organic fertilizers applied to arable soils;
application of organic fertilizers from livestock grazing	– the amount of droppings left on the grazing fields of agricultural animals;
application of N with the remains of field crops	– the amount of N in plant residues (and, accordingly, the amount of residues themselves) that remain in the fields after harvesting and are plowed into the soil;
cultivation of organic soils	– the area of organic soils set aside for field crops;
mineralization or immobilization of N associated with the movement of organic matter in the soil	– the amount of N lost as a result of soil management (tillage, fertilization, plowing of plant residues, etc.);

Continuation of Appendix 2 to the Plan

weathering N	– the amount of N applied to the soil from various sources;
leaching N	– the amount of N applied to the soil from various sources;
rice cultivation	– the area of agricultural soils devoted to rice and the amount of applied organic fertilizers;
application of urea	– amount of urea applied to arable soils;
liming of soils	- the amount of used liming materials.

The agricultural sector has a significant contribution to the total emissions of greenhouse gasses in Ukraine, which during 1990-2021 fluctuated between 7-14%. Despite the general trend towards a decrease in greenhouse gas emissions from agricultural activities, the contribution of agriculture to total emissions is gradually increasing (Figure A2.1).

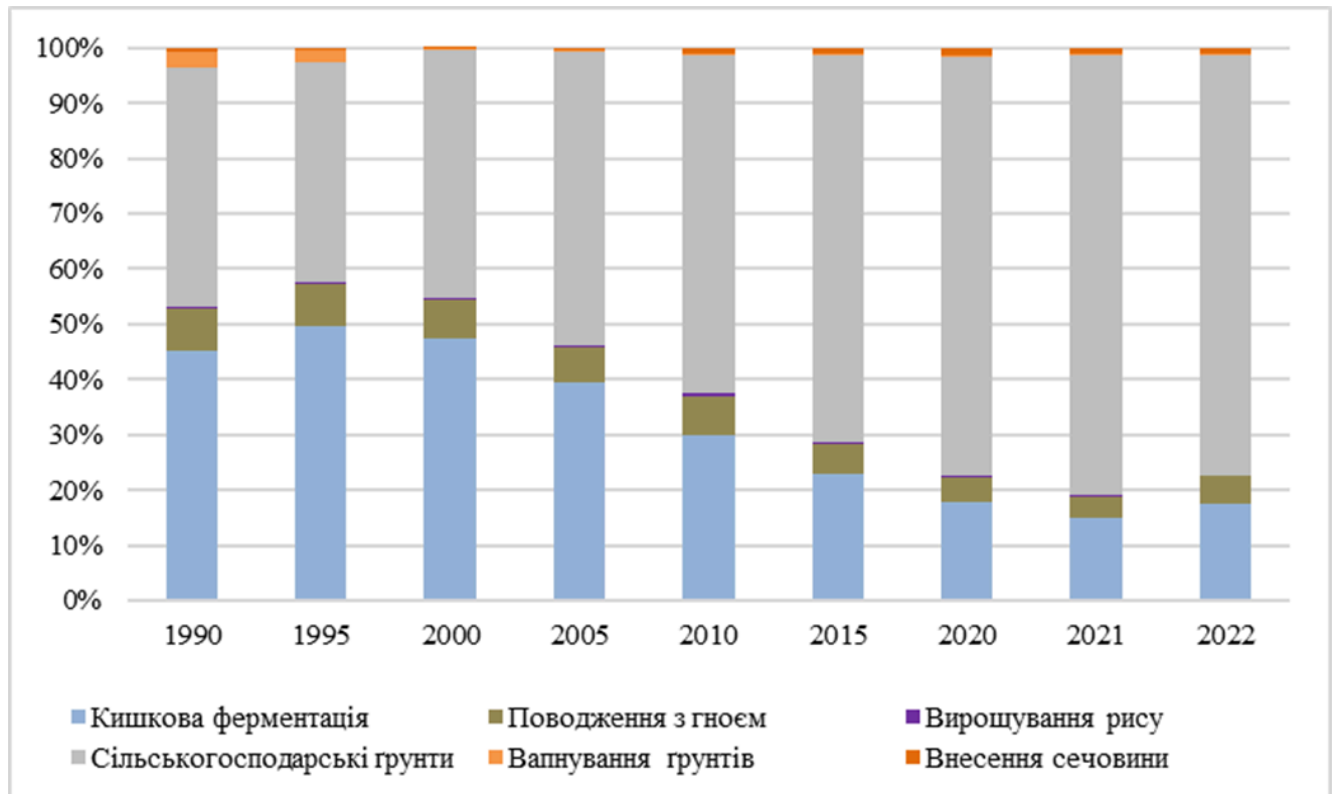
Figure A2.1. GHG emissions from agriculture (million tons of CO₂-eq) and contribution to total emissions (%) in Ukraine



The full-scale invasion of the Russian Federation into Ukraine, which began on February 24, 2022, led to significant changes in the agricultural sector, in particular, there was a reduction in the number of farm animals, the ratio of manure management systems changed, the volume of applied mineral and organic fertilizers decreased, and the area of land used for field crops (both sown and harvested areas) decreased, the volume of the gross harvest, and accordingly, the yield, etc., decreased. Such changes led to a reduction of greenhouse gas emissions in 2022 by almost 24% (according to preliminary data) compared to the previous year (Figure A2.1).

The reduction of greenhouse gas emissions occurred in all agriculture subsectors, but the categories "Rice cultivation" and "Agricultural soils" turned out to be the most "vulnerable" (table A2.2). It should be noted that the technology of rice cultivation is a high-tech activity and is carried out in the South of Ukraine, and therefore it has experienced the most large-scale (both direct and indirect) impact from hostilities during 2022.

Figure A2.2. The dynamics of the contribution of categories of agricultural activity to GHG emissions, %



Continuation of Appendix 2 to the Plan
Assumptions regarding the main parameters of agricultural development

Category	Unit	NDC	2022	2030	2040	2050
Total cattle in Ukraine	thousand heads	3,697	2,682.92	2,984.65	3,305.36	3,508.01
Cattle in agricultural enterprises	thousand heads		1,011.43	1,112.58	1,246.08	1,345.77
Cows in agricultural enterprises	thousand heads		423.82	466.20	522.15	563.92
Cattle in households	thousand heads		1,671.49	1,872.07	2,059.28	2,162.24
Cows in households	thousand heads		1 127.79	1,263.12	1,389.43	1,458.90
Total sheep in Ukraine	thousand heads		770,920	801,757	841,845	858,682
Ewes and lambs from 1 year and older in farms of all forms of ownership	thousand heads		524,790	545,781	573,070	584,532
All pigs in Ukraine	thousand heads		5,531.71	6,125.37	6,272.92	6,301.64
Pigs in agricultural enterprises	thousand heads		3,507.30	3,858.03	4,050.93	4,212.97
Main sows in agricultural enterprises	thousand heads		220.42	242.46	254.58	264.76
Piglets from 2 to 4 months in agricultural enterprises	thousand heads		1,005.89	1 106.48	1,161.80	1,208.28
Pigs on fattening in agricultural enterprises	thousand heads		1,317.69	1,449.46	1,521.93	1,582.81
Pigs in households	thousand heads		2,024.41	2,267.34	2,221.99	2,088.67
The main sows in households	thousand heads		118,29	132.48	129.83	122.04
Piglets from 2 to 4 months in households	thousand heads		445.37	498.81	488.84	459.51
Pigs on fattening farms	thousand heads		656.84	735.67	720.95	677.70
All horses in Ukraine	thousand heads		174,661	178.15	179.94	176.34
All goats in Ukraine	thousand heads		501,196	521.24	526.46	521.19
Total buffaloes in Ukraine	thousand heads		0.095	0.30	0.32	0.35
Total rabbits in Ukraine	thousand heads		4,551,996	4,734.08	4,686.73	4,639.87
Total birds in Ukraine	thousand heads	257,300	203,020,248	221,003,700	222,549,760	222,878,400
Poultry in agricultural enterprises	thousand heads		115,928,719	125,203.02	127,707.08	128,984.15
Chickens and roosters in agricultural enterprises	thousand heads		113,849,339	122,957.29	125,416.43	126,670.60
Geese in agricultural enterprises	thousand heads		46,715	50.45	48.94	48.45
Ducks in agricultural enterprises	thousand heads		255,378	268.15	260.10	257.50
Turkeys in agricultural enterprises	thousand heads		822,220	863.33	854.70	846.15
Poultry in households	thousand heads		87,091,530	95,800.68	94,842.68	93,894.25
Chickens and roosters in households	thousand heads		72,488,059	79,736.86	78,939.50	78,150.10
Geese in households	thousand heads		3,563,229	3,812.65	3,774.53	3,736.78
Ducks in households	thousand heads		9,818,918	10,604.43	10,498.39	10,393.40
Turkeys in households	thousand heads		801,279	821.31	813.10	804.97
The amount of milk from one cow in agricultural enterprises	kg/day head		17.32	17.50	18.00	18,20
The amount of milk from one cow in households	kg/day head		12.89	13.00	13.30	13.40

Continuation of Appendix 2 to the Plan

Average cut from 1 head in all categories of farms	kg/year		3.04	3.09	3.17	3.20
Applied for field crops (without rice), expert data	kg N/year		1,365,545,488	1,800,000,000	2,200,000,000	2,500,000,000
Applied for rice, expert data	kg N/year		255,500	4,500,000	4,750,000	4,800,000
Annual amount of urea used as fertilizer	t		486,232	698,423	733,345	770,012
Annual amount of applied limestone flour	t		294,000	308,700	324,135	340,341
Total area of harvested crops in Ukraine	thousand hectares	29,245	25,693	25,994	29,342	29,118
<i>Grain crops</i>	thousand hectares		12,973.38	13,941.13	15,767.11	15,612.15
winter wheat	thousand hectares		5,824.03	6,238.32	7,043.41	6,973.66
spring wheat	thousand hectares		220.90	161.87	183.60	181.73
corn for grain	thousand hectares		4,410.92	4,709.10	5,345.34	5,290.46
winter barley	thousand hectares		949.02	1,079.06	1,212.34	1,200.74
spring barley	thousand hectares		1,089.78	1,225.45	1,381.38	1,367.85
winter rye	thousand hectares		102.59	147.11	166.92	165.21
spring rye	thousand hectares		1.30	0.85	0.97	0.96
winter triticale	thousand hectares		7.30	7.00	7.91	7.87
spring triticale	thousand hectares		0.40	0.85	0.97	0.96
oat	thousand hectares		162.92	159.83	179.69	178.78
buckwheat	thousand hectares		121.80	79.78	90.00	89.54
sorghum	thousand hectares		21.17	41.22	45.92	45.70
millet	thousand hectares		56.57	78.56	88.28	87.84
rice	thousand hectares		1.40	8.63	16.46	16.94
other grain crops, hybrids, corn mixtures	thousand hectares		3.30	3.49	3.94	3.92
<i>legumes</i>	thousand hectares		210.55	293.92	328.77	327.15
bean	thousand hectares		38.47	41.58	46.96	46.72
horse beans	thousand hectares		2.30	1.62	1.83	1.82
chickpeas	thousand hectares		3.10	7.17	8.11	8.06
lentil	thousand hectares		3.00	4.62	5.21	5.18

Continuation of Appendix 2 to the Plan

pea	thousand hectares		149.69	222.73	249.62	248.38
winter vetch	thousand hectares		0.10	0.34	0.39	0.38
spring vetch	thousand hectares		1.70	2.36	2.60	2.59
sweet lupine	thousand hectares		1.30	2.90	3.28	3.26
bitter lupine	thousand hectares		0.10	0.26	0.29	0.29
other grain and leguminous crops	thousand hectares		10.80	10.32	10.48	10.46
<i>technical</i>	thousand hectares		8,817.32	8,172.34	9,206.76	9,159.79
soy	thousand hectares		1,571.17	1 141.41	1,288.40	1,281.76
peanut	thousand hectares		0.03	0.04	0.05	0.05
flax curl (oily)	thousand hectares		46.02	34.61	37.76	37.60
long flax (for seeds)	thousand hectares		0.00	0.10	0.10	0.10
mustard	thousand hectares		25.43	23.91	26,25	26,14
winter rape	thousand hectares		1,194.97	837.10	945.06	940.18
spring rape	thousand hectares		24.60	27.93	31.56	31,39
sesame	thousand hectares		0.00	0.00	0.00	0.00
sunflower	thousand hectares		5,750.42	5,887.93	6,630.24	6,596.50
castor	thousand hectares		0.00	0.00	0.00	0.00
camelina	thousand hectares		0.10	0.00	0.00	0.00
oil poppy	thousand hectares		0.00	1.71	1.93	1.92
Central Russian and Southern hemp (for seeds)	thousand hectares		0.20	1.70	1.64	1.63
pumpkins (seeds)	thousand hectares		5,10	6.41	7.24	7.20
other oil crops	thousand hectares		1.57	0.90	1.01	1.01
cotton	thousand hectares		0.00	0.00	0.00	0.00
jute, kenaf and other textile bast fibers	thousand hectares		0.00	0.00	0.00	0.00
long flax (straw)	thousand hectares		0.00	0.40	0.39	0.38
hemp (straw)	thousand hectares		0.80	0.30	0.29	0.29
other spinning crops	thousand hectares		0.00	0.00	0.00	0.00
factory sugar beet	thousand hectares		184.29	193.61	218.76	217.63
sugar beet	thousand hectares		0.00	0.03	0.03	0.03
sugar beet (seeds)	thousand hectares		0.52	0.52	0.53	0.53
sugar cane	thousand hectares		0.00	0.00	0.00	0.00
spices	thousand hectares		0.60	2.73	3.09	3.07
essential oil crops	thousand hectares		3.90	5.98	6.76	6.72
medicinal plants	thousand hectares		1.80	3.25	3.67	3.65
plants that are used mainly in perfumery, pharmaceuticals or as insecticides, fungicides, etc	thousand hectares		0.00	0.00	0.00	0.00
tobacco	thousand hectares		0.90	0.85	0.97	0.96
shag	thousand hectares		0.00	0.00	0.00	0.00
chicory	thousand hectares		2.40	0.00	0.00	0.00
energy plants	thousand hectares		2.50	0.94	1.06	1.06
other technical crops	thousand hectares		0.00	0.00	0.00	0.00

Continuation of Appendix 2 to the Plan

<i>roots and tubers, vegetable and melon food crops of open ground</i>	thousand hectares		1,748.32	1,597.76	1,798.96	1,789.81
potato	thousand hectares		1,282.07	1 125.10	1,267.90	1,261.43
sweet potato	thousand hectares		0.00	0.00	0.00	0.00
manioc	thousand hectares		0.00	0.00	0.00	0.00
edible roots and tubers with a high content of starch and inulin, others	thousand hectares		0.00	0.00	0.00	0.00
open and closed soil vegetable crops	thousand hectares		424.30	417.22	468.67	466.32
root vegetable crops	thousand hectares		0.00	0.00	0.00	0.00
melon food crops	thousand hectares		41.34	55.01	61.89	61.58
seeds of annual vegetable crops	thousand hectares		0.11	0.18	0.20	0.20
seeds of biennial vegetable crops	thousand hectares		0.10	0.09	0.10	0.10
seeds of perennial vegetable crops	thousand hectares		0.10	0.09	0.10	0.10
seeds of food melon crops	thousand hectares		0.30	0.09	0.10	0.10
<i>fodder</i>	thousand hectares		1,943.48	1,988.99	2,240.44	2,229.03
fodder root crops	thousand hectares		166.80	151.50	171.03	170.15
fodder sugar beet	thousand hectares		0.60	0.68	0.77	0.77
fodder beet (chard), rutabaga	thousand hectares		0.00	0.00	0.00	0.00
fodder root crops, other	thousand hectares		0.00	0.00	0.00	0.00
fodder melon crops	thousand hectares		41.39	43.81	49.49	49.24
fodder corn	thousand hectares		204.71	189.10	213.18	212.09
annual grasses for hay	thousand hectares		154.53	172.78	194.06	193.09
annual herbs for green fodder, hay, silage, grass meal	thousand hectares		56.10	81.43	91.30	90.85
perennial grasses for hay	thousand hectares		648.80	606.28	683.49	679.99
perennial grasses for green fodder, hay, silage, grass flour + perennial grasses for grazing	thousand hectares		113.66	120.47	135.80	135.11
haymakers for hay	thousand hectares		536.67	595.87	671.06	667.64
haymakers for green fodder, hay, silage, grass meal	thousand hectares		5.88	5.80	6.54	6.51
pastures are cultivated for hay	thousand hectares		3.80	4.95	5.60	5.57
pastures are cultivated for green fodder, hay, silage, grass meal	thousand hectares		4.67	7.24	8.08	8.04
other fodder crops	thousand hectares		1.41	1.34	1.36	1.36
fodder beet seeds	thousand hectares		0.09	0.17	0.18	0.18

Continuation of Appendix 2 to the Plan

seeds of fodder melon crops	thousand hectares		0.00	0.34	0.39	0.38
seeds of annual herbs	thousand hectares		0.20	1.71	1.93	1.92
seeds of perennial herbs	thousand hectares		4.16	5.41	6.09	6.06
seeds of other fodder crops	thousand hectares		0.00	0.09	0.10	0.10
root crops fodder uterine	thousand hectares		0.00	0.00	0.00	0.00
Organic farming	thousand hectares	1000	264*	1,240**	1 310	1 365
Productivity increase	%	10% from 2016-20 19		State Statistic s data for 2021	5% of the indicato rs for 2030	5% of the indicato rs for 2040
Annual area of arable/drained organic soils (data from the State Water Agency)	hectares		471,602, 000	471,602, 000	470,000	470,000
Utilization of manure for biogas	t (16%)	16				

Notes:

**Data submitted by the Ministry of Agrarian Policy to the State Statistics Service.*

***The indicator is envisioned by the National Economic Strategy for the period until 2030, approved by the Resolution of the Cabinet of Ministers of Ukraine of March 3, 2021 No. 179 (Official Gazette of Ukraine, 2021, No. 22, Article 1015).*

Methodology for modeling the development of the energy system of Ukraine in the TIMES-Ukraine model

The TIMES-Ukraine model is a linear optimization model of the energy system (of the "bottom-up" type), which describes in detail all energy flows in Ukraine ⁵¹⁴.

In the TIMES-Ukraine model, the energy system of Ukraine is divided into seven sectors (Fig. D3.1), which includes all energy flows from the extraction of primary energy resources to their final consumption with intermediate stages of transformation (processing, production of secondary energy resources, etc.) , import, export and transportation. This corresponds to the methodological approach of the State of the Union, which, in turn, is harmonized with the relevant methodologies of the European Commission (Eurostat) and the International Energy Agency (IEA).

TIMES-type models contain a significant number of technologies in different sectors of the energy system, providing information about different types of energy, technologies, etc. Currently, the TIMES-Ukraine model includes almost 2,000 technologies, both existing in Ukraine and those that exist on international markets and can be implemented in Ukraine. The sources of data for cost and technical characteristics are the materials of the IEA, the Danish Energy Agency (DEA), the National Laboratory of Renewable Energy Sources (NREL), specialized associations in Ukraine, scientific institutes, and energy companies.

The TIMES-Ukraine model complies with the methodological recommendations of the Secretariat of the UN Framework Convention on Climate Change regarding the development of energy and environmental forecasts ⁵¹⁵ . A recent model is capable of achieving net-zero greenhouse gas emissions across the economy, which has been highlighted in a number of peer-reviewed publications ^{516,517,518}

⁵¹⁴ Podolets R.Z., Dyachuk O.A. Strategic planning in the fuel and energy complex based on the "TIMES-Ukraine" model: Sci. add. NAS of Ukraine; Institute of Economics and predicted - K., 2011. - 150 p.

⁵¹⁵ The UNFCCC Resource Guide for preparing the National Communications of Non-Annex i Parties. Module 4: Measures to mitigate climate change // United Nations Framework Convention on Climate Change. Retrieved from https://unfccc.int/resource/docs/publications/08_resource_guide4.pdf

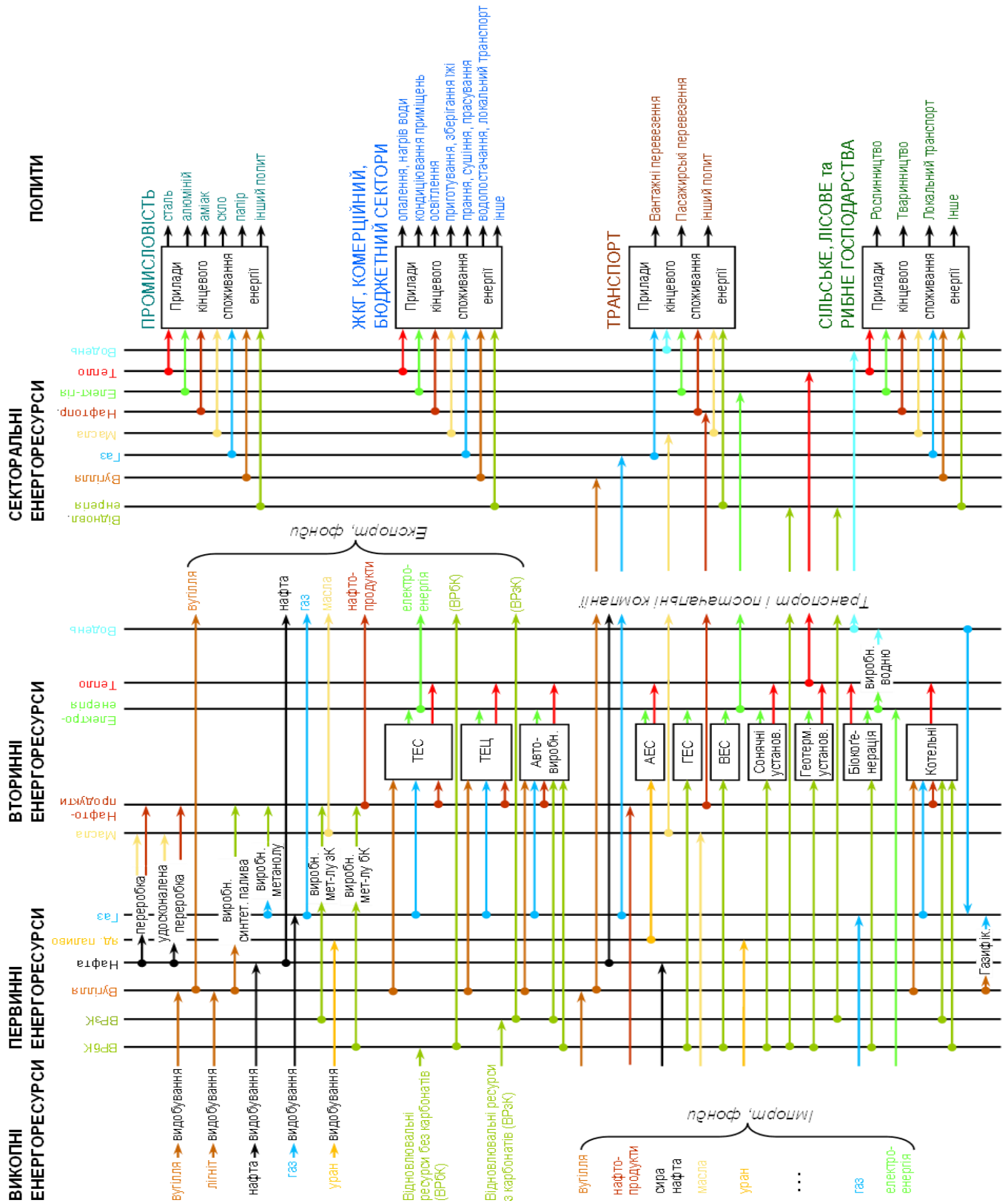
⁵¹⁶ Roman Podolets, Oleksandr Diachuk, Andrii Semeniuk, Bohdan Serebrennikov, Galyna Trypolska, Roman Yuhymets, Olha Yevstihnieieva Rebuilding Ukraine with a resilient, carbon-neutral energy system // United Nations Economic Commission for Europe, 2023 https://unece.org/sites/default/files/2023-07/EN_Rebuilding%20Ukraine%20with%20a%20Resilient%20Carbon-Neutral%20Energy%20System_V8.pdf

⁵¹⁷ Maksym Chepeliev, Oleksandr Diachuk, Roman Podolets, and Andrii Semeniuk What is the future of nuclear power in Ukraine?

The role of war, techno-economic drivers, and safety considerations // Energy Policy, Volume 178, July 2023. - <https://doi.org/10.1016/j.enpol.2023.113612>

⁵¹⁸ Maksym Chepeliev, Oleksandr Diachuk, Roman Podolets, Andrii Semeniuk (2023) Can Ukraine go "green" on the post-war recovery path? // Joule, <https://doi.org/10.1016/j.joule.2023.02.007>

Fig. D3.1. The basic structure of the energy system in the TIMES-Ukraine model



Continuation of Appendix 3 to the Plan

The database of the TIMES-Ukraine model is filled with economic and energy data for 2005-2020, as well as estimates of the corresponding data for 2022, taking into account their changes in the future. The main sources of the database are statistical observations of the State Statistics Service, the National Bank of Ukraine, data from Ukrainian ministries and departments, housing and communal enterprises, energy generating and energy supply companies, specialized associations, academic institutions, etc. In addition, data from international organizations (MEA, IAEA, OECD, IMF, World Bank, UN, etc.) are used in the part of energy and economic development forecasting.

Energy system models, such as TIMES-Ukraine, are commonly used for long-term analysis of energy system development pathways around the world, including widespread in the European Union at both the pan-European and national levels. By changing assumptions about useful energy demand, technology, prices or other external variables, numerous scenarios can be created and analyzed, including decarbonisation scenarios for the buildings sector. First, a scenario (or a set of scenarios) is developed without the introduction of relevant measures (Baseline, Business As Usual scenario), and in the next step, policy scenarios are developed (for example, policies to increase energy efficiency, develop renewable energy sources (RES) or reduce GHG, decarbonization) by overlaying additional restrictions or goals for the energy system (or its component, such as the building sector) to assess the impact (effect) of the implementation of the policies under study. The result of the simulation is the evaluation of the least expensive solutions for the entire energy system under the given conditions and restrictions.

The TIMES-Ukraine model was used to prepare a number of strategic documents approved by the Government of Ukraine in 2016-2021, in particular: National Energy Efficiency Action Plans until 2020 and for 2019-2030; Ukraine's expected Nationally Determined Contribution to the Paris Agreement and its updated version; Strategies for low-carbon development of Ukraine until 2050, Strategies for thermal modernisation of buildings in Ukraine until 2050, etc.

In recent years, the Institute of Economics and Forecasting of the National Academy of Sciences of Ukraine has been applying and developing this model in cooperation with US national laboratories, in particular with the Pacific Northwest National Laboratory, the National Renewable Energy Laboratory (NREL), Argonne National Laboratory (Argonne National Laboratory) and Lawrence Berkeley National Laboratory (Lawrence Berkeley National Laboratory) as part of the Net Zero World initiative. For example, in December 2023, at COP28 in Dubai, as part of the program of the Ukrainian pavilion, the results of modeling the post-war low-carbon development of the Ukrainian energy industry⁵¹⁹ were presented, which were also presented in the form of a report⁵²⁰. Also recently, a joint study was conducted with DIXI group, REKK, Austrian Institute of Technology, and Regulatory Assistance Project on long-term ways of decarbonization of the electricity sector of Ukraine, where the TIMES-Ukraine model was used in combination with the EPMM and Green-X models⁵²¹.

Continuation of Appendix 3 to the Plan

Table D.3.1. A concise list of promising technologies for the production of electrical and thermal energy

Technologies	Capital expenditure (CAPEX), €/kW _e										
	2020	2025	2030	2035	2040	2045	2050	Efficiency (electrical) , %	KVVP, %	Expiry term, years	Coef. a burst of heat
Thermal power plants (TPP) and Thermal power plants (TPP)											
Nuclear power plant											
New large power units	4400							33	88	60	0.03
Extending the service life of existing power units	254							33	80	30	0.04
New small modular reactors (160 MW)	4400							33	90	80	0.04
Atomic high-temperature reactor with hydrogen production	7650-6885							33	94	60	0.1-0.12
Gas (natural/biomethane/synthetic methane)											
Combined cycle gas turbine	1000							60	50	35	0.15
Open cycle gas turbine	600							40	50	30	0.15
Quick start gas piston engine (maneuvering power)	1000							50	75,5 22	35	–
Combined cycle gas turbine + Carbon capture	2450							51	50	35	0.05
Open cycle gas turbine + Carbon capture	2050							34	50	30	0.05
CHP combined cycle	800							50	50	35	0.84
CHP of an open cycle	920							45	50	35	0.95
Extending the operating life of existing CHPs	280-650							19-43	50	15	1.1-3.0
Combined cycle thermal power plant + Carbon capture	2250							45	50	35	0.84
Bioenergetics											
TPP on wood biomass	2800	2750	2700	2650	2600	2550	2500	24	50	30	–
TPP on incinerated household waste	2900	2850	2800	2750	2700	2650	2600	23	50	30	0.3
Biogas TPP	3200	3200	3200	3200	3200	3200	3200	42	50	30	–
TPP on wood biomass + Carbon capture	3650							24	50	30	–
Biogas TPP + Carbon capture	5350							42	50	30	–
TPP on energy plants + Carbon capture	3750							24	50	30	–
CHP on wood biomass	3400	2850	2800	2750	2700	2650	2600	20	50	35	2.0
CHP on biomass from waste	3400	2950	2850	2850	2900	2750	2700	19	50	35	1.9
CHP on energy plants	3400	3150	3100	3050	3000	2950	2900	20	50	35	2.0
CHP on wood biomass + Carbon capture	4450							20	50	35	1.5
CHP based on energy plants + Carbon capture	4450							20	50	35	1.5
Wind power plants (WES)											
Ground-based wind power plants	1100	1075	1050	1000	950	900	850	–	32	30	–
Sea-based wind power plants	2120	1960	1800	1700	1680	1660	1640	–	42	30	–
Solar power plants (SPP)											
Industrial solar power plants without a tracker	75 0	72 5	70 0	63 0	56 0	51 0	47 5	–	12.5	25	–
Industrial solar power plants with a tracker	92 0	85 0	80 0	72 0	64 5	59 0	54 0	–	14.5	25	–

Continuation of Appendix 3 to the Plan

Rooftop solar power plants	90 0	87 5	85 0	80 0	75 0	70 0	60 0	—	13.5	25	—	
Geothermal power plants (GeoES)												
Geothermal power station	4300-3600							—	35-55	25	—	
Hydroelectric power plants (HPP)												
Small hydroelectric power stations	3250-3080							—	30	40	—	
Large hydroelectric power plants	3300-3100							—	33-36	60		
GAES	610							—	26	60	—	
Energy storage installations (ESS), Euro/kWh												
Electric batteries	1042	832	622	508	394	324	255	92	17	25	—	
Underground storage of hydrogen	980	750	700	650	600	550	500	100	100	30	—	
Tank storage of hydrogen, large volumes	4600	3600	3400	3200	3000	2800	2500	100	100	22	—	
Tank storage of hydrogen, small volumes	2650	2075	1900	1800	1700	1600	1500	100	100	22		
Fuel cells (Hydrogen)												
TPP and CHP based on fuel cells	2530	1125	1125	844				50	60	10	0.64	
Heating plants (Boiler plants)												
Gas boiler room (with the possibility of bio- or synthetic methane)	300							92	50	40	—	
Boiler room on wood biomass	14 5	14 2	14 0	13 8	136			85	50	35	—	
Biomass boiler house from industrial waste	35 0	32 0	30 0	28 0	27 0	26 0	25 0	80	50	35	—	
Boiler room on aerothermal energy	1100							250	50	25	—	
Hydrogen boiler house	390							64	50	35	—	
Other important technologies												
Direct Carbon Capture from the Air (DAC)	2.3 2	2.0 5	1.8 6	1.8	1.7	1.6	1.5	0.014- 0.007 PJ/kt CO2	90	25	—	
Methanation	600	500	450	400	350	300	250	75-83 (H2)	95	25	—	
Production of direct reduction iron (DRI) from hydrogen	360	355	350	345	340	333	324	17 PJ H 2/mt	85	40	—	
Low-carbon production of iron ore concentrate	96							64-75	1	30	—	
Alkaloid electrolyzer	650	500	450	375	300	275	250	67-75	97	25-35	—	
Electrolyzer with a proton-exchange membrane (PEM)	925	800	650	550	450	425	400	58-71	97	20-30	—	
Solid Oxide Cell Electrolyzer (SOEC)	4500	3200	1900	1620	1340	1060	780	77.5-83.5	91	10-20	—	
Steam reforming of methane, large capacity			10.6					77	90	20	—	
Steam reforming of methane, low capacity			22					69	80	20	—	
Solar steam reforming of methane, large power			9.8					120	90	20	—	
Solar steam reforming of methane, small power			27					60	90	20	—	
Gasification of biomass into hydrogen, of high capacity			63. 4	47.6				50	90	20	—	
Gasification of biomass into hydrogen, low capacity			111	95				33	71	20	—	
Steam reforming of ethanol			234					67	90	20	—	

Methodology for forecasting GHG emissions in the waste management sector

The assessment of GHG emissions in the waste management sector was carried out in accordance with the principles and methodologies of the 2006 IPCC Guidelines for National GHG Gas Inventories⁵²³ (hereinafter referred to as the 2006 IPCC Guidelines), therefore the sources of GHG emissions do not correspond to the types of economic activity, but to the categories recommended in the above-mentioned methodologies (IPCC categories) in the "Waste" sector. Accordingly, emissions from the management of agricultural residues, as well as relevant GHG emission reduction policies, were taken into account either in the LULUCF sector or in the energy sector, if such policies were accompanied by useful energy production. GHG emissions that are accompanied by the beneficial use of energy during waste treatment, such as biogas recovery at landfills, as well as energy production at waste incineration plants and waste incineration in cement production, have been taken into account in the Energy sector, but the effect of reducing GHG emissions as a result of carrying out the corresponding activities were taken into account in the waste management sector. The assessment of GHG emissions in the "Waste" sector was carried out in strict accordance with the methods and taking into account the emission factors used to report⁵²⁴ Ukraine's national GHG emissions within the framework of obligations under the UN Convention on Climate Change and the Paris Agreement. For example, the assessment of methane emissions due to waste disposal in landfills was carried out using the first-order decay method, as recommended in the 2006 IPCC Guidelines.

General assumptions and methodological principles for determining data on activities in the "Waste" sector. The following indicators and trends were used during modeling in the Waste sector by category, where sector-specific indicators are highlighted in italics:

Disposal of solid waste: *population, specific volumes of solid waste generation (domestic waste) per inhabitant, waste management practices (proportion of disposal, reuse, recycling, composting, incineration), coverage of the population by the system of centralized waste collection, construction of new sanitary (deep managed) landfills, composition of landfills, proportion of flaring and biogas recovery at landfills.*

In order to ensure the principle of transparency, the model of the mass balance of household waste used during the modeling of GHG emissions in the "Waste" sector is shown in Figure A2.1, from which the following basic provisions of mathematical modeling follow:

1. The total amount of generated household waste corresponds to the amount of officially and illegally buried household waste⁵²⁵. The initial data for estimating the volume of the household waste generation are: population, coverage of the population by the system of centralized solid waste collection, specific volume of solid waste generation per inhabitant.
2. After estimating the volumes of the household waste generation, these volumes are divided into separate streams of household waste components, the value of which, in turn, is determined on the basis of their component (morphological) composition. These streams are: paper and cardboard, food waste and food industry waste at all stages of production and consumption, waste from green spaces, wood, personal hygiene products, rubber and leather, textiles and non-biodegradable components (including ferrous metals, non-ferrous metals, glass, plastic, dangerous and other inorganic waste). At the same time, household waste that is not covered by the centralized collection system is disposed of in unmanaged shallow landfills.
3. Food waste and food industry waste at all stages of production and consumption and waste from green areas as part of the stream of mixed MSW form a stream for composting (biological treatment), the volume of which is determined by the total share of composting.

⁵²³ <https://www.ipcc-nggip.iges.or.jp/public/2006gl/>

⁵²⁴ <https://unfccc.int/documents/628276#main-content>

⁵²⁵ Unspecified practices (e.g. home composting, gray recycling, etc.) of household waste management not covered by the centralized collection system are excluded from the mass balance because they do not result in significant GHG emissions.

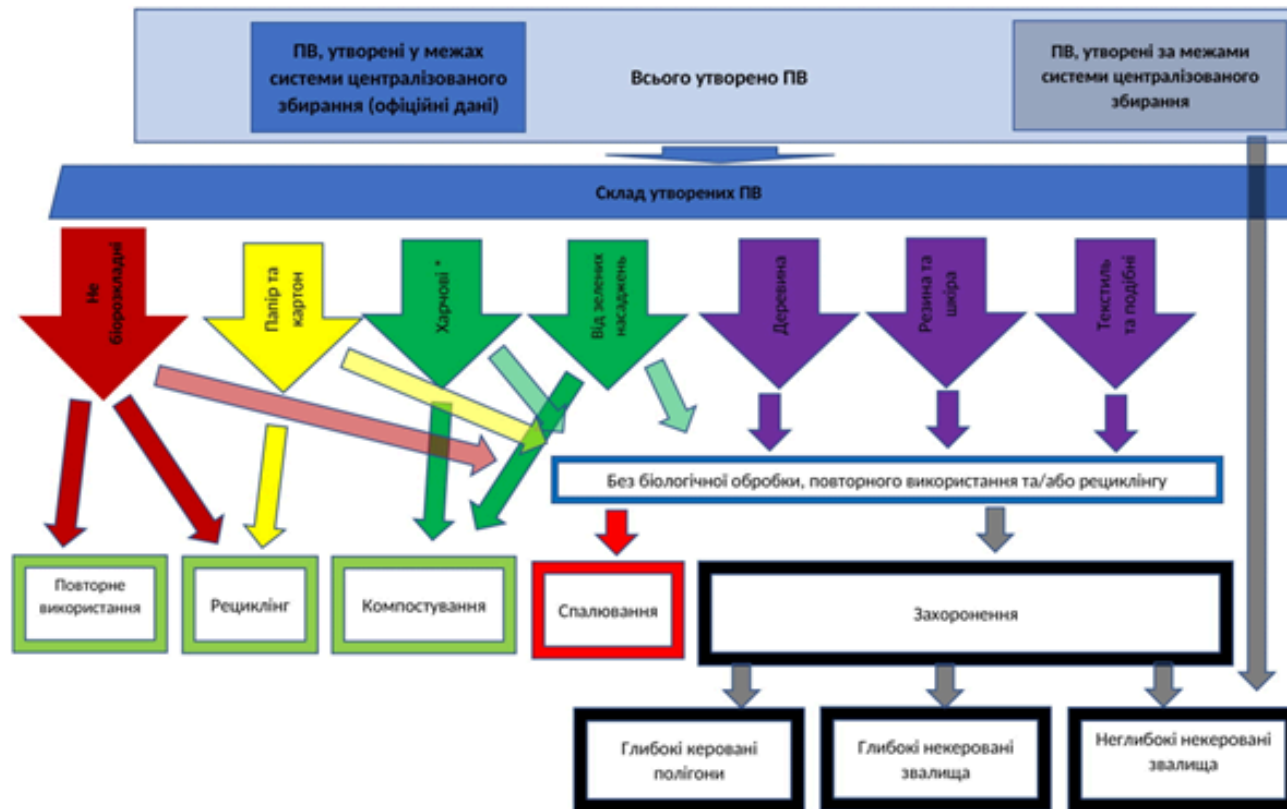
4. Glass forms a stream for reuse, the volume of which is determined by the share of reuse.
5. Paper, cardboard and non-biodegradable components (in particular, plastics and metals) form a stream for recycling, the volume of which is determined by the total share of recycling.
6. The rest (remainder) of household waste is divided into two streams: incineration and disposal, which in turn are determined by the share of incineration.
7. The distribution by types of disposal sites is determined by the construction of new sanitary landfills.

Biological processing (composting) of solid waste: population, indicators of the development of the industrial and agricultural sectors, *specific volumes of solid waste generation per inhabitant, the share of composting and composting technologies.*

Incineration and open burning of waste: GDP growth, industrial sector development indicator, *category-specific legislation (ban on incineration of waste without energy use).*

Treatment and discharge of wastewater: population, share of urban and rural population, indicators of sector development (energy, ferrous metallurgy, agriculture, food industry, etc.), *share of treatment and discharge; consumption of meat products, dairy products and fruits per inhabitant, development of technologies, share of flaring and recovery of methane formed during wastewater treatment.*

Figure A4.1. General scheme of the mass balance model of household waste (mass flows)



* Food waste and food industry waste at all stages of production and consumption

It should be noted that the issue of increasing RES waste (including components of solar panels and wind turbines) and their processing methods for the purposes of modeling GHG emissions in the "Waste" sector was not considered, because such emissions are insignificant in the context of forecasting emissions by IPCC emission sources in the "Waste" sector. The question of growing biomass with the aim of its further use for energy purposes was also not considered in the "Waste" sector, because according to the IPCC definitions, such activity is not evaluated in the "Waste" sector.

Adherence to the principle of "Do no significant harm" in the context of the development of waste thermal treatment technologies

The principle "Do No Significant Harm" is the basis for prioritizing the development of this or that technology under the conditions of sustainable development of the country. It is based on the concept that the development of activities that cause a significant negative impact on the environmental goals defined in Article 17 of EU Regulation 2020/852 cannot be encouraged.

Considering that only modern technologies of thermal treatment of waste can comply with the principle of "No significant harm" and taking into account the five-level hierarchy of waste defined in Directive No. 2008/98/EC, in which thermal treatment methods are in the penultimate place in order of priority, in both the WEM and WAM scenarios, waste heat treatment technologies found limited use. Thus, according to the WEM scenario, the share of heat treatment will reach 7% by 2030 and 10% by 2050; and under the WAM scenario – 8% by 2030 and 15% by 2050. These indicators are significantly lower than the corresponding indicators of those European countries that have made significant progress in the transition to a circular economy: for example, the share of thermal treatment of solid household waste in Switzerland is about 48%, in Belgium - 46%; Sweden – 59%; Denmark - 39%, etc. For more details, see Figure 5.5, which shows the main indicators of solid household waste management in European countries for 2022.

Moreover, it is possible that in the long term, with the further development of thermal treatment technologies, the role of these technologies in the waste management system in Ukraine may be revised in the direction of intensifying their distribution, provided the principle of "Doing no significant harm" is observed.

The target indicators of thermal treatment of solid waste in Ukraine in both WEM and WAM scenarios, on the one hand, were agreed with the normative legal documents in the field of waste management in Ukraine, and on the other hand, correspond to the recommendations provided in the framework of a number of projects of international technical assistance to Ukraine on sustainable and low-carbon development of the waste management system in Ukraine, including:

- the international technical assistance project "Assessment of technological needs in Ukraine" for the waste sector, carried out in 2018-2020 within the framework of GEF funding and implemented by UN Environment and UNEP DTU Partnership.
- the international technical assistance project "Supporting investments in the system of sustainable solid waste management in Ukraine", with the financial support of the Multidonor Account for Ukraine, was implemented by the European Bank for Reconstruction and Development in 2017.

Calculation of the target indicator of the annual reduction of energy consumption

The calculation of the target indicator of the annual reduction of energy consumption (hereinafter - the target indicator) was carried out in accordance with the Methodology for determining the target indicator of the annual reduction of energy consumption, approved by the order of the Ministry of Infrastructure of November 2, 2023. No. 1006. The target indicator is calculated in absolute values of final energy consumption. The target indicator should be at least 0.8 percent of the total annual volume of energy supply to consumers, averaged over the period from January 1, 2017 to December 31, 2019. Volumes of energy supply in the field of transport are not taken into account when calculating and setting the target indicator.

The target indicator is calculated in thousands of tons of oil equivalent (hereinafter - thousands of tons of oil equivalent) according to the formula:

$$CPU = SP \times 0.008 \quad (1)$$

CPU - set target indicator, thousand t.e.;

SP - the total annual volume of energy supply to consumers, averaged over the period from January 1, 2017 to December 31, 2019, thousands toe, which is calculated according to the formula:

$$C\Pi = \frac{\sum_{p=2017}^{2019} KСр}{3}, \quad (2)$$

KSr - the amount of final consumption of energy resources for the corresponding year according to the official data of the State Statistics Service on the energy balance of Ukraine (excluding final consumption of energy resources in the field of transport) in 2017, 2018 and 2019, thousands toe

The State Statistics Service data used to calculate the target indicator are shown in the table below.

Continuation of Appendix 5 to the Plan

Final energy consumption for 2017 - 2019, thousand toe

	Sector	2017	2018	2019
¹	<i>Industry</i>	15098	16487	16122
²	<i>Residential</i>	16487	16201	14007
³	<i>Commercial and public services</i>	4337	4742	4831
⁴	<i>Agriculture, forestry and fishing</i>	1847	1880	1882
⁵	<i>Other activities</i>	0	0	0
⁶	<i>Non-energy use</i>	2515	2645	2796
⁷	<i>Final energy consumption (without transport)</i>	39786	41328	36842
⁸	Average final energy consumption (without transport) for 2017-2019	39319		