

APPROVED

by the Ordinance of the Cabinets of Ministers of
Ukraine
of 25 of November 2015 № 1228-p

NATIONAL ENERGY EFFICIENCY ACTION PLAN until 2020

BACKGROUND AND EXECUTIVE SUMMARY

In accordance with the decisions of the Energy Community of December 2009, September 2010 and October 2011, the Contracting Parties of the Energy Community (including Ukraine) are in the process of implementation of the following European Directives on energy efficiency:

- Directive 2006/32/EC on energy end-use efficiency and energy services;
- Directive 2010/31/EC on the energy performance of buildings;
- Directive 2010/30/EC on labeling of energy products.

Directive 2006/32/EC of the European Parliament and of the Council on energy end-use efficiency and energy services requires that the EU Member States prepare three National Energy Efficiency Action Plans (hereinafter - NEEAPs).

The task force on energy efficiency was established in the Energy Community in December 2007 to support and ensure the coherent implementation of the Directives by the Contracting Parties of the Energy Community, including the tasks of the preparation of NEEAPs and the establishment of a system for monitoring and evaluation of their implementation.

The Contracting Parties to the Energy Community are bound with the same obligation to develop and implement NEEAPs as the EU member countries, the only difference is the later deadlines for achieving their targets, due to the later start.

So, in the case of Ukraine, which became a Contracting Party to the Energy Community Treaty (EnCT) on February 1st, 2011, the first National Energy Efficiency Action Plan of Ukraine sets the targets for the period from 2015 to 2020.

The National Energy Efficiency Action Plan until 2020 (hereinafter - the National plan) has been developed on the basis of the National Energy Efficiency Action Plan template as prepared for the Contracting Parties of the Energy Community in accordance with the requirements of the Directive.

Realization of measures in the framework of implementation of the National plan will enable to achieve the major goal in 2020 — national energy

saving target — of 9% compared to the average domestic final energy consumption for the period 2005-2009. Moreover, NEEAP contains an intermediate energy savings target of 5% in 2017.

The above mentioned target does not apply to the energy consumers covered by Directive 2003/87/EC of 13 October 2003 establishing a scheme for greenhouse gas emission trading within the Community as well as to the final consumers, which energy consumption is classified into sectors of air and water inland transport.

Absolute values of the targets have been defined with the use of the data collected by the State Statistics Service of Ukraine. While, the set and characteristics of the energy efficiency policies (actions) have been provided by the State Agency on Energy Efficiency and Energy Saving of Ukraine.

For this NEEAP, TIMES-Ukraine model was used, that is a linear dynamic optimization model where the demand is preset, which describes the entire energy system of Ukraine and enables the analysis of long-term energy consumption dynamics on the basis of estimated change in the consumer technological structure. The model has been developed by the state-owned Institute of Economics and Forecasting of the National Academy of Sciences of Ukraine. The intended function of TIMES-Ukraine model was to get consumer energy needs satisfied while minimizing overall costs (maximizing the benefits of all stakeholders), simultaneously estimating required investments and operational costs, structure of primary supply and final energy consumption.

At the beginning of the second millennium, 60% of Ukraine's total primary energy supply was provided from the domestic sources, where coal accounted for 21.8-25.6%, natural gas – for 9.2-11.3%, oil - for 2.6-2.8% and electricity generated at nuclear, hydro and pump storage hydro power plants – for 11.5-16.0%. So far, the structure of total primary energy supply does not correspond to the resource potential of Ukraine.

The final energy consumption experienced the impacts of the same factors as the TPES and did not demonstrate any strongly pronounced stable trends.

Although the primary energy intensity and final energy intensity indicators have been decreasing fast, they still remain rather high as compared to those in the EU countries (Figure 1, 2).

The average final energy consumption is estimated by the energy balances annually compiled by the State Statistics Service of Ukraine in accordance with the methodological approach of the International Energy Agency (IEA).

On the basis of final energy consumption statistical indicators for the period from 2005 to 2009, the national intermediate energy savings target of 3 612 ktoe in 2017 and the overall national energy savings target of 6 501 ktoe in 2020 are set (see Chapter I).

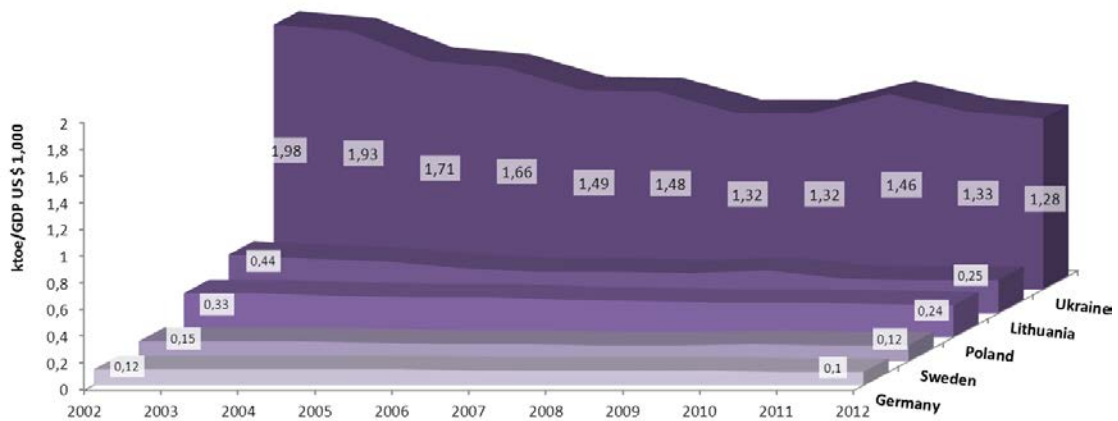


Figure 1. Total primary energy supply and other countries, 2002-2012, toe/GDP \$1000 (2005)

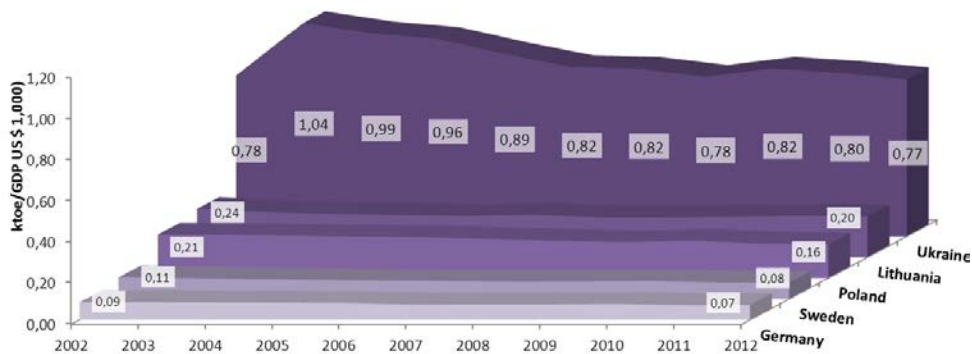


Figure 2 Final energy intensity dynamics in some countries, 2002-2012, toe/GDP \$1000 (2005)

Achieving this target is expected in the course of the National plan implementation – Ukraine should introduce significant legislative, financial and other measures for the complete implementation of the Directive.

The implementation of the set of measures required to achieve the national indicative target of energy saving shall require significant financial resources to be mobilized, energy efficiency improvement governmental activities to be expanded and the energy market to be further liberalized, public-private partnerships in the energy efficiency area to be developed, etc.

This National plan takes into consideration this specific feature and provides recommendations as to the implementation of policy and regulatory

measures to provide efficient support to the implementation of the Directive and facilitate the widespread application of cost-effective technological innovations.

Energy efficiency improvement measures for residential sector (households) include:

- introduction of individual energy consumption metering in full;
- improving of the building codes (specifically, annual increase in the number of new nearly zero-energy buildings);
- introduction of energy auditing and certification schemes, energy labeling and identification of information on the energy consumption of all energy-related household appliances;
- introduction of minimum energy efficiency standards;
- financial support to households for the implementation of energy upgrade interventions in their homes;
- conducting awareness campaigns oriented to low-cost energy savings via changing of consumer energy behavior and larger scale actions.

For the services sector including commercial buildings and public body buildings, the main challenges are to carry out thermal modernization actions (in particular, by engaging energy service companies), to promote the exemplary role of the public sector as stipulated by the Directive. Policy measures in this area include introduction of complete individual energy metering, introduction of stricter building codes, introduction of energy auditing, energy management and certification, etc.

For the industry sector, which still lags behind in the use of state-of-the-art industrial technologies, and thus is consuming more fuel per unit of industrial output, an urgent priority is to modernize production processes. The measures foreseen in order to achieve this target include:

- engagement of ESCOs;
- energy labeling and specifying standard information on consumption of energy and other resources by energy-intensive productions;
- launching of energy auditing and energy management schemes in industries;
- introducing the EU minimum industrial equipment standards;
- conducting targeted awareness campaigns oriented to manufacturers on the potential of energy savings in industry.

The major priority tasks for improving energy efficiency in transport to be implemented in the scope of measures of the National plan include development of a market for cleaner, more energy-efficient and safer vehicles through incentives like:

- easier access to city centers by public transport;
- creating of parking lot systems;
- optimizing public transport routes;
- development of electric transport, etc.

In the course of the National plan implementation, Ukraine should further take significant regulatory, financial and institutional actions to ensure complete implementation of the Directive.

Implementation of the measures towards achievement of the indicative targets requires mobilization of significant financial resources, the energy efficiency improvement activities, which our state committed to extend, and further liberalization of the energy market in future, particularly, concerning the energy services, as well as development of public-private partnerships in the area of energy efficiency. Expected level of investment is estimated at 35 070 million Euros until 2020. The main sources of financing will be the Fund of energy efficiency, local budgets, funds of international financial organizations and private investments, in particular energy service companies.

Chapter 1 of the National plan presents the overall national energy savings target, specific conditions for macroeconomic indicators assessment and the energy consumption structure, sector contributions to the target, assessment and monitoring methodology of the energy savings according to the Directive. Chapter II describes the key sectors for final energy consumption, offers sectoral presentations and assessment of energy efficiency improvement programs, measures and energy services. Chapter III offers an analytical description of horizontal and cross-sectoral measures in terms of impacts and implementation pathways. Chapter IV presents grouping of the measures requested by the Directive, and chapter V describes planned legislative changes to transpose the Directive into the Ukrainian law.

CHAPTER I

National target for energy saving in 2017 and 2020

1.1 Determining national energy saving target in accordance with the requirements of the Directive

According to Article 4 of the Directive, EU member states shall adopt and aim to achieve national indicative energy savings target of 9 % for the ninth year of application of this Directive, to be reached by way of energy services and other energy efficiency improvement measures. Member states shall take cost-effective, practicable and reasonable measures designed to contribute towards achieving this target. This national indicative energy savings target shall be set and calculated in accordance with the provisions and methodology set out in Annex I of the Directive.” This methodology prescribes calculating national targets on the basis of annual average consumption for the five-year period preceding the implementation of the Directive.

In the case of Ukraine, the national targets were calculated in compliance with the provisions of the Directive, namely:

the period for the calculation of the average consumption was defined from 2005 to 2009;

the national intermediate target has been set at 5% for 2017;

the national target has been set at 9% for 2020.

Table 1. FEC for the period of 2005-2009, ktoe

	2005	2006	2007	2008	2009
1. Final Energy Consumption (FEC)	74238	74303	74067	75984	63266
2. FEC excluded by the Directive,	164	173	181	117	40
of which:					
2.1. Air transport	29	38	46	2	2
2.2. Inland water transport	135	135	135	115	38
3. FEC covered by the Directive,	74074	74130	73886	75867	63226
of which:					
3.1. Household sector	24229	25383	23013	22845	22084
3.2. Services sector	2386	2695	2745	4952	4176
3.3. Industry (in the sphere of this Directive)	33219	32769	34130	30939	22616
3.4. Transport	11610	11463	12153	15024	12356
3.5. Agriculture	2630	1820	1845	2107	1994

The calculation of the average Final Energy Consumption is based on the energy balances annually composed by the State Statistics Service of Ukraine according to the methodological approach of the International Energy Agency (IEA).

Based on the FEC data for the period of 2005-2009 (Table 1), Ukraine's annual average consumption is estimated at 72237 ktoe and consequently the national energy savings target at 3612 ktoe in 2017 and the overall national target at 6501 ktoe in 2020 (Table 2).

Table 2. Average FEC (ktoe) used to identify the National Targets according to the Directive

Indicator	Average for 2005-2009		
	Other types of fuel and energy	Electricity	Total consumption
1. Final Energy Consumption (FEC)	61327	11044	72372
2. FEC excluded by the Directive,	135	-	135
of which:			
2.1. Air transport	23	-	23
2.2. Inland water transport	112	-	112
3. FEC covered by the Directive,	61192	11044	72237
of which:			
3.1. Household sector	20986	2525	23511
3.2. Services sector	1665	1726	3391
3.3. Industry (in the sphere of the Directive)	25077	5658	30735
3.4. Transport	11666	855	12521
3.5. Agriculture	1799	280	2079

RESULTS

FEC covered by the Directive:	72 237
National energy savings target for 2017 (5%)	3 612
National energy savings target for 2020 (9%)	6 501

1.2. Specific Conditions for Estimation of the National Target

Macroeconomic Indicators

During 2000-2008, the average growth rate of Gross Domestic Product (hereinafter – GDP) was 6.9%. For a long period of time, the availability of cheap energy has been providing an opportunity for manufacturing industries to maintain a high level of export earnings, providing a positive current external account and reasonable economic growth. Conscious government policy to

support export-oriented spheres by providing tax exemptions, other indirect subsidies, lower rates of environmental payments contributed to this.

After the trade balance deficit occurred for the first time in 2005, and the next year demonstrated the overall payment balance deficit (fig.1.2), the fact of further increase of energy-intensive products export was perceived as a forced necessity: growth of the balance deficit by 4% of GDP was not critical, but the share of these industries' outputs in the export goods structure increased by mere 1-2%. In other words, together with exports of metallurgical and chemical products, the export of other industries also increased, and against the background of general macroeconomic statistics the reasons emerged to speak of the time for structural reforms.

However, despite the optimistic goals, against the background of economic growth and mitigated social problems, the structural and institutional reforms needed for sustainable long-term development of economy were retarded. As a result, when in the second part of 2008 the external conditions changed, reaction of the economy to the negative external shock was strong. According to the results of 2009, the Ukrainian GDP fell by 14.8%, or by 36.7% from the level of 1990 and composed \$117.2 billion. The growth of GDP in 2010-2011 was 4.1% and 5.2%, respectively (table 1.3), and was mainly attributed to a conservative comparison basis and favorable external market conditions.

Despite the decline in actual energy demand due to the increased price of imported natural gas and imposed limits on the gas uptake, the energy imports in that period reduced twice less than the commodity exports.

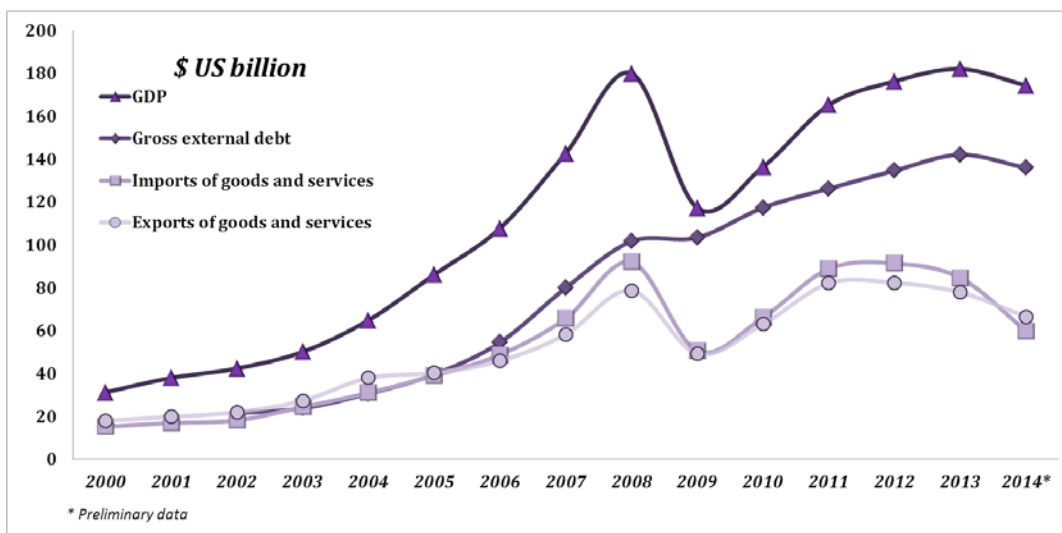


Figure 3. Trends of the main macroeconomic indicators

Decline of the overall global economic activity led to a decrease in demand on the international markets of the major Ukrainian export commodities, thus preventing normal recovery of the national economy. The

conditions of foreign trade further worsened because of the protectionist measures implemented by the trade partner countries. In turn, the slowdown of foreign trade negatively affected the economic development of Ukraine through the growth of negative current account balance of payments and the decline in outputs and incomes of domestic manufacturers.

Primary supply and final consumption of energy

In Ukraine, three characteristic periods in the trends of primary supply and final energy consumption (FEC) can be distinguished. First period - the recession years of 1991-1999, that was a result of the collapse of the Soviet Union in 1991 – is distinguished with a disastrous decline in GDP (60% during the period) and the corresponding reduction in energy consumption.

During the period from 2000 to 2007, the energy consumption stabilized with minor growth (average annual growth rate - 0.4%) against a background of more rapid growth of GDP (average annual growth rate - nearly 7.7%). Primarily, this is due to sectoral shifts in the economy that took place during that period - faster growth of trade, services and the financial sector, which provided a significant contribution to the GDP growth. Another important factor was the modernization of production facilities, which enabled reducing energy intensity of the main production types.

During 2008-2010, the trend of primary supply and final energy consumption was shaped by the global financial crisis, which largely determined the commodity production structure of export-oriented industries (metallurgical, chemical, engineering) within these years, and which, in turn, affected the mining (ore and coal) and electric power sectors.

The period of extensive economic development in the previous years was not used in full for restructuring of the economy, which imbalance and enormous energy intensity of the economy intensified the inertial nature of the fuel and energy sector and prevented the necessary reforms. Whether the state policies and programs has been implemented efficiently in the energy sector one can find out from the fact that until 2010 the structure of primary energy supply almost had not changed (Figure 4). For example, the share of gas in overall supply of primary energy consumption decreased from 46% in 2001 to 42% in 2010 after some short-term reduction in 2008-2009 caused by the halted gas deliveries from Russia in winter 2009. As late as from 2011, primarily due to the price factor, the primary supply structure demonstrated the trend to broader diversification of fuels. At the same time, during the economic recession, the competitiveness of Ukrainian products could not be ensured even by limiting the enterprises' current assets and investments in the production modernization.

The share of domestic coal output was always smaller than that of mostly imported gas and remains stable at the level of 2000. Only after the increase in the cost of imported natural gas in 2005, and especially in 2011, coal slightly managed to press down the share of oil and natural gas in the overall energy consumption structure.

In 2009, overall supply of primary energy decreased compared to 2005 by 19.8% to 114,537 Mtoe. The most significant decrease was observed in gas supply (-39.5%). The reduction of natural gas share took place mainly due to its substitution by coal for thermal power plants, steel plants, cement plants and other manufactures. Given this decrease, the average indicators for overall supply of primary energy over 2005-2009 are higher compared to 2009 data.

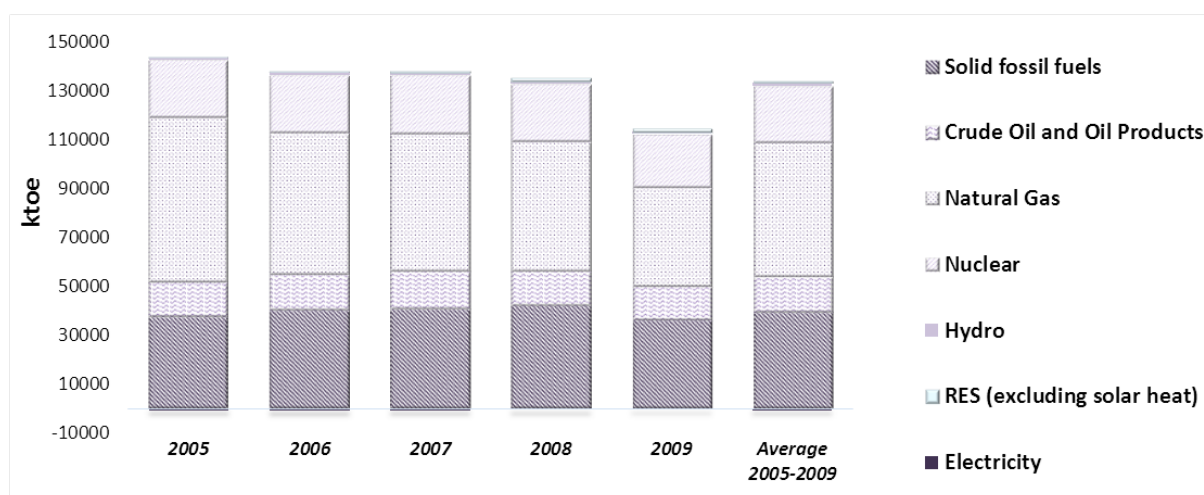


Figure 4. Overall supply of primary energy

The dynamics of final energy consumption was influenced by the same factors as the indicators of overall energy supply and had no pronounced stable trends.

The structure of final energy consumption by sector during 2005-2009 did not experience any significant changes. Due to the decrease of industrial output, the share of industry fell by 12.2%.

Table 3. Structure of final energy consumption in Ukraine by sectors, %

Sectors	2005	2006	2007	2008	2009	Average 2005-2009	
	%						knoe
Industry	44,7	44,1	46,1	40,7	35,7	42,5	30 735
Transport	15,9	15,7	16,7	19,9	19,6	17,5	12 657
Services	3,2	3,6	3,7	6,5	6,6	4,7	3 391
Households	32,6	34,2	31,1	30,1	34,9	32,5	23 511
Agriculture	3,5	2,4	2,5	2,8	3,2	2,9	2 079
Total	100	100	100	100	100	100	72 372

Over 2005-2009, the average final energy consumption in Ukraine was 72 372 ktoe (Table 3), where the share of gas made 37.9%. or 27 396 ktoe. The

average electricity consumption was 11 044 ktoe or 15.3%. Remaining energy resources, except renewable energy sources had approximately the same share as electricity of 14.0-16.0%. Although the use of renewable energy resources doubled in 2008-2009, their average share has not exceeded 1% (Table 4).

Table 4. Structure of final energy consumption in Ukraine by types, %

Fuel and energy	2005	2006	2007	2008	2009	Average indicator for 2005-2009
	%					knoe
Coal and Peat	14,4	14,9	15,8	12,7	11,9	14,0
Crude Oil and Oil Products	15,0	15,8	16,8	15,8	17,0	16,0
Natural Gas	39,2	38,4	37,3	38,4	35,7	37,9
Renewable Energy Sources (excluding solar heat)	0,3	0,7	0,7	1,6	1,6	1
Heat (district heating)	16,9	15,1	13,7	16,2	17,6	15,9
Electricity	14,3	15,0	15,7	15,3	16,2	15,3
Total	100	100	100	100	100	100

Energy Intensity

In 2005, the energy intensity of the primary energy use was 1.934 ktoe/€ GDP and final energy intensity – 1.005 ktoe/€ GDP in 2009 prices; in 2009 these indicators decreased to 1.363 ktoe/€ GDP and 0.753 ktoe/€ GDP, accordingly. Although both indicators are rapidly decreasing, they still remain much higher compared to the EU member states. In the recent years, the reduction of GDP energy intensity slowed, and in individual years, even its increase was observed. In general, this can be explained by several reasons:

an uneven drop in the outputs of processing industries was compensated by the output growth and energy consumption in other industries of real sector;

a drop in the industrial output resulted in increase of energy expenses in the structure cost in physical and monetary terms.

This means the increase of energy share in the structure of semi-fixed costs which is used for heating, and/or indoor lighting, other needs and is not used in production directly, that means that it does not depend on the product output.

Overall, the decrease in the GDP energy intensity during the recent years could hardly be deemed a result of the governmental policy, taking into account

the similar dynamics in the other post-Soviet countries. Rather, such trajectory is due to the peculiarities of the GDP calculation methodology, similar demographic situation and favorable external market conditions for export-oriented economies (Table 5).

Table 5. Energy intensity of GDP, ktoe/€GDP, in 2009 prices

Indicator	2005	2006	2007	2008	2009	Average indicator for the period of 2005-2009
Primary energy intensity (overall supply of primary energy, ktoe/€1000 GDP)	1,934	1,518	1,281	1,091	1,363	1,392
Final energy intensity (final energy consumption, ktoe/€1000 GDP)	1,005	0,822	0,691	0,616	0,753	0,756

1.3. Energy system scenarios and distribution of the national target by sectors

Methodological approach

To prepare this National plan the TIMES-Ukraine model was used, that is linear dynamic optimization model where the demand is preset, which describes the entire energy system of Ukraine and enables the analysis of long-term energy consumption dynamics on the basis of estimated change in the consumer technological structure. The intended function of the TIMES-Ukraine model is to get consumer energy needs satisfied while minimizing overall costs (minimizing the losses of all stakeholders), simultaneously estimating required investments and operational costs, structure of primary supply and final energy consumption. For example, where the scenario of energy sector development supposes the increase of demand on residential building illumination (due to the decline in expenses for illumination or due to relevant assumed growth in the GDP and quantity of households), the model should make a choice whether to increase the generation capacity (or intensity of the capacity use), or to install more efficient illumination devices. In this situation, there is a competition between generating equipment and end-use devices as to meeting certain energy demand.

The model is selected by type of fuel and type of generating equipment or end-use devices takes place by the analysis of parameters of alternative technologies and economic characteristics of energy supply and consumption, as

well as energy and environmental policy criteria. TIMES-Ukraine is thus a vertically integrated model of the entire energy system. On the demand side, the model, after examining the competitiveness of various technologies by price-to-efficiency ratio of end-use devices, which satisfy the demand for useful energy and taking account of constraints imposed by the supply system, determines desirable penetration by each energy technology in the various energy applications purely on the basis of financial criteria.

The energy system in the model is divided into seven sectors: sector of energy supply; generation of electricity and heat; industry; households; services; transport; agriculture. The industrial sector is actually represented only by processing industry, since mining of energy resources and power sector are included in the model for the energy sector, in accordance with the structural scheme of energy balance and their fuel consumption for their own needs, while transportation losses are not included in the final energy consumption.

Industries inside the model are divided into two categories by the level of unit energy intensity. Energy-intensive branches are represented by production technologies for manufacturing of main product types. This means their energy demand is production of a unit of output (steel, aluminum, ammonia, cement, lime, paper, glass, etc.). Energy intensive branches include iron and steel production, chemical production, manufacture of other non-metal mineral products, production of pulp and paper. For the rest of branches, the structure of energy flows is standard and consists of four conventional technologies that satisfy the needs for technological heat, machine drives and other processes.

In the TIMES-Ukraine, the transport sector is represented by the following types of transportation: road, railway, pipelines, air and water. Transport services, which are provided by technologies of road and rail transport, are used for transportation of passengers and freights. Railway transport is divided into passenger and freight transport and includes subway as well.

Energy consumption by households is determined by the ten most energy intensive categories of consumer needs, such as heating and cooling of dwellings, water heating, lighting, cooking, refrigerating appliances (refrigerators), clothes washing and drying (ironing), dishwashing etc., for the satisfying of which electricity and/or other type of fuel is needed.

Energy system models like the TIMES-Ukraine are used to carry out scenario experiments on possible changes in the energy system. To research an effect from change in the exogenous assumptions (for example, regarding dynamics in the demand for useful energy, specifications of energy technologies, energy prices trajectory) additional (to the baseline) scenarios are being developed to identify the main factors of influence on the stability of the power system and conduct appropriate sensitivity analysis. Imposing additional restrictions on the general conditions of energy sector functioning (for example, setting targets) allows to conduct analysis of individual policies scenarios (set of regulatory measures). The policy scenario that was build for this study is derived

from an exploratory scenario by imposing national energy efficiency target. For both scenarios (basic and energy efficient) model calculates the least cost (or maximum surplus) on the designated trajectory of the system, providing appropriate assessment of the supply structure and energy use by sectors and types of fuels, dynamics of energy sources prices, optimal technological structure of energy generators and consumers and so on. Thus, the total saving and corresponding costs per sector specified in NEEAP were identified as the difference between the scenarios. In this document, the scenario of energy-efficiency policies was built by imposing on the basic scenario of national energy savings targets. Thus, energy savings and associated expenses by sectors and types of energy efficiency measures specified in NEEAP were identified as the difference between the scenarios.

Energy System Scenarios

To assess the impact of the energy efficiency policy on the energy system in Ukraine, the basic and energy efficiency scenarios take account of the following common characteristics as existing technological facilities, availability of domestic resource and import options, and near-term policy interventions. In order to formulate these scenarios, all available national data sources (State Statistics Service, Ministry of Energy and Coal Industry and other) as well as some international databases (including the International Energy Agency (IEA)) were utilized. The demand for energy resources in both scenarios is driven by economic and demographic indicators of Ukraine development.

As expected, there will be a significant drop in Ukrainian economy in 2014-2015 with some gradual growth starting from 2016. Short-term projection of GDP for Ukraine was based upon data from the international rating agency Standard & Poor's, which projects a decline in 2014 for about 7%. In 2015, zero GDP growth in Ukraine is expected, and in 2016 and 2017, Ukrainian economy can reach 3% and 4% growth, respectively. In the following years, the gradual growth of GDP is expected due to the long-term assumptions about the dynamics of industrial production (first of all in the steel and chemical industries). According to these projections, Ukrainian GDP will reach the level of 2012 only in or after 2017. Ministry of Economic Development and Trade of Ukraine holds to the same vision of development, although GDP projections for 2016-2017 prepared by the Ministry are a bit more optimistic.

To determine the demographic drivers, the projections of the Institute of Demography and Social Research, Ukrainian National Academy of Sciences were used, as they are considered. Projections of the UN Department of Economic and Social Affairs were also considered.

Energy price projection is based on the World Energy Outlook 2013, prepared by the International Energy Agency with the use of World Energy Model (WEM), which is similar to TIMES-Ukraine model.

Baseline Scenario

The baseline scenario according to the macroeconomic development of Ukraine described above presumes no radical changes in technological structure of the energy sector, being focused on extension of operating time of existing capacities with certain acceptance of changes of their performance under the existing schedule of repair and renovation. Due to depreciation and loss of certain share of old capacities, certain diversification of energy flows through involvement of new but not improved technologies is allowed.

In addition, the baseline scenario includes a number of technical (technological) assumptions.

Potential of increase in natural gas production from existing fields is insignificant. It is assumed that domestic gas production may increase by 5% in 2020 compared to 2012. The potential of unconventional gas (shale gas, coalbed methane, etc.) is not considered in the baseline scenario; the prospects to increase oil extraction seem weak, and it is expected that domestic crude oil production may not exceed the level of 2012 more than by 2-3%. The potential of annual coal mining is required by the model and it is assumed that in 1-2 years the coal resource base, which is now in the territory, which is not controlled by Ukrainian authorities, will be returned and available. The uranium ore supply will not be self-sufficient before 2020.

The lifetime of nuclear units, which lifetime will soon be expired, is going to be extended. The share of NPPs in the structure of electricity generation will not exceed 50%. It is clear that economically feasible potential of large HPPs is 10.5 GW, and small HPPs - 1.5 GW, potential of WPPs is 15 GW, potential of large solar PPs is 4 GW. The development of gas thermal power plants depend on the development of wind farms and solar power plants, since the united power system should provide maneuvering facilities. Potential of solar and geothermal energy in the residential and non-residential buildings makes up to 15% of the corresponding energy demands. Installed capacity of cogeneration plants and CHPs on biofuel may increase up to 10 GW. In addition, the biomass in the energy end-use sectors has significant potential for heating residential and non-residential buildings, and water heating. The centralized heat generation by large boilers will be on the current level and will provide at least 25% of the final demand. Exports of electricity to European countries will be up to 10 billion kWh in 2020.

Open-hearth steel production technologies will be gradually decommissioned by 2020 and replaced with other types of production; in cement industry the switching of "wet" technologies of cement production to a "dry" method is further expected; introduction of new stimulating mechanisms (in addition to those that are already implemented) of state support for the end-users in the households and services sectors to promote energy saving and the use of energy efficient equipment is not expected; environmental constrains are not incorporated in the baseline scenario.

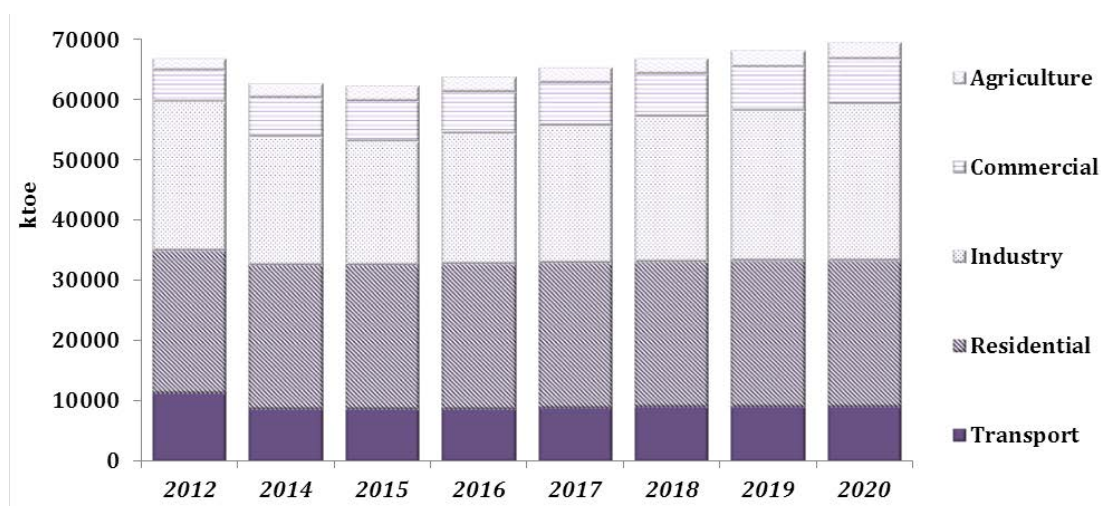


Figure 5. Dynamics of overall final energy consumption in the baseline scenario by sectors

Compared to the average final energy consumption in 2005-2009, FEC in 2017 will decrease by 9.5 %, and in 2020 – by 3.9%. The largest increase of energy consumption will be observed (after 2014) in industry, services sector and agriculture, while transport and households remain steady consumption sectors.

According to the baseline scenario (Figure 5), primary energy intensity (in 2009 prices) in 2017 will decrease by 31.4%, and in 2020 - by 37.2% compared to the corresponding average for 2005-2009. Accordingly, the final energy intensity will decrease to 32.3% in 2017 and 37.6% in 2020.

Energy efficiency scenario

Except the national energy saving target that was introduced in the energy efficiency scenario according to the National plan requirements, several additional assumptions were made. Compared to the baseline scenario, the EE scenario includes new building standards and requirements to improve the efficiency of boilers, as well as an assumption that the state policy and programs will promote an increased penetration of energy efficient appliances (such as compact fluorescent lamp (CFLs), refrigerators, air conditioners). Under the EE scenario it is assumed that new buildings in the households and services sectors will be built under the standards adopted in 2009 (State building codes of Ukraine, <http://dbn.at.ua>) and by 2020 renovation works can be held at one third of the existing housing stock and premises of the services sector. Renovation of the existing buildings covers all types of insulation technologies, including replacement of windows, insulation of roofs, walls, etc.

With TIMES-Ukraine model, the dynamics of final use of energy resources consumption by sectors under the energy saving scenario was forecasted (Figure 6).

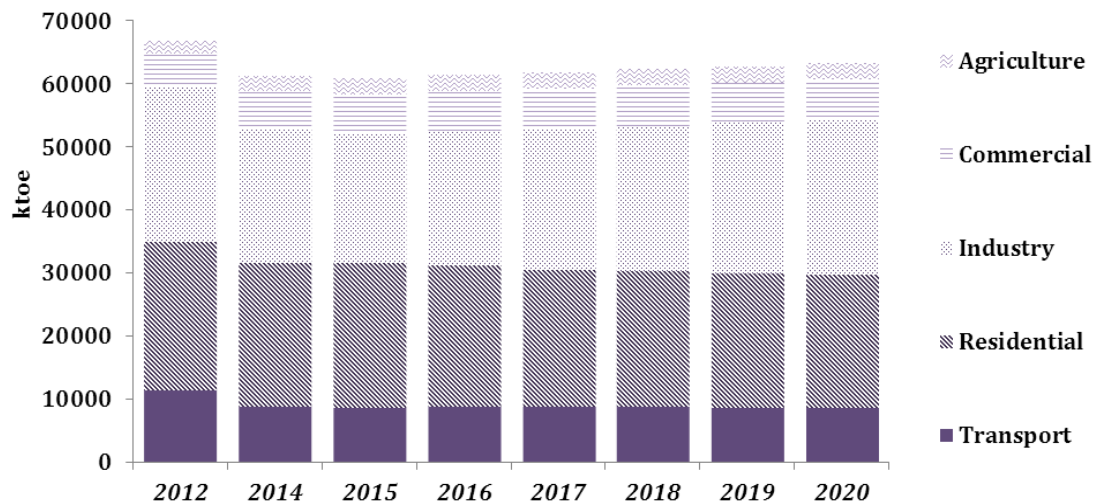


Figure 6. Dynamics for final energy consumption in the energy efficiency scenario

Distribution of targets by sectors

The total energy savings were estimated as the difference between the two scenarios described above (baseline and energy efficiency) (Table 6). The intermediate target for 2017 was calculated by the same approach.

Table 6. Expected final energy consumption (FEC) upon the plans are implemented

Year	2012	2013	2014	2015	2016	2017	2018	2019	2020
Forecast GDP dynamics, %	0,2		-7		3	4	5,5	5	4
Expected FEC by normal market development, Mtoe	66,9	64,6	62,9	62,4	63,9	65,4	66,9	68,2	69,4
Indicative target, Mtoe						3,6			6,5
FEC after implementation of EEI measures, Mtoe						61,8			62,9

Similar estimates were made to distribute the final energy consumption reduction target by sectors (Table 7). In view of these results, we can conclude

that all sectors have significant energy savings potential, but the greatest contribution to this process can be expected from households (almost half, 49.6%). Smaller share of industry in energy efficiency compared to the amount of its consumption can be explained by the fact that the measures in homes are more economically attractive and a payback period is shorter. One can expect that during the implementation of energy savings potential in the households sector, after 2020 the share of industry will be much higher.

Table 7. Distribution of expected results by sectors

Sectors – final energy users	Distribution of expected results	Share of expected results, indicator
	ktoe	%
Household sector	3226	49,6
Industry*	1610	24,8
Services	1041	16,0
Transport	624	9,6
Total	6501	100

* Industry includes agriculture

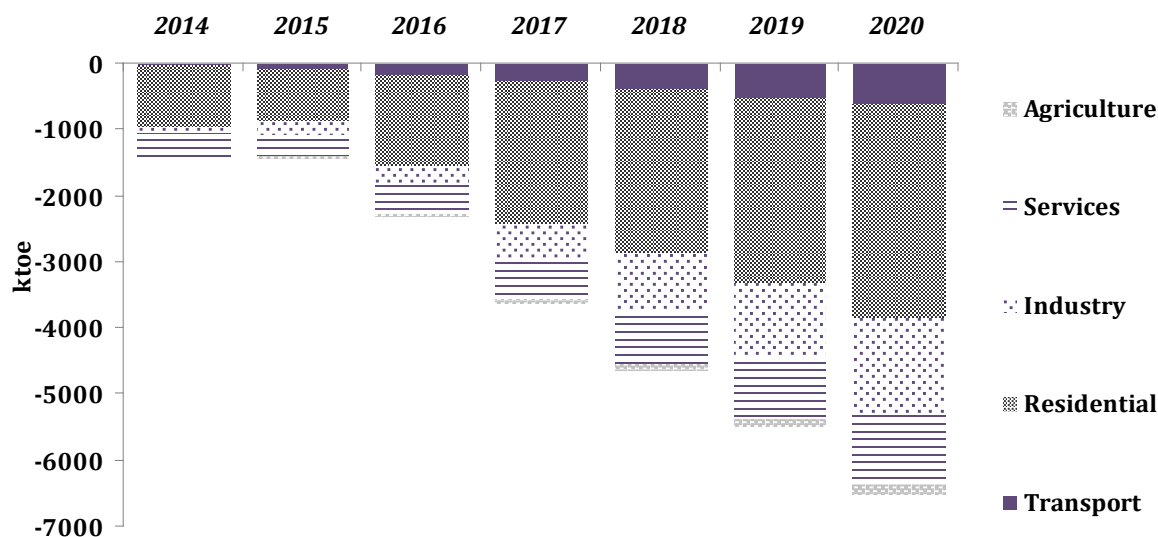


Figure 7. Energy savings by sectors

In the residential sector, heating modernization system (including rehabilitation, replacement of boilers, heat pumps), increasing share of district heating and water-heating equipment (including possible use of solar collectors) can provide the largest contribution (78%) in energy efficiency. Energy savings

can be achieved through the use of energy efficient (electric) devices and advanced lighting.

In the structure of energy efficiency in the services sector, as in residential sector, the upgrading of space heating (57%), where the same measures can be applied, takes big share. Modernization of (replacing) existing internal and street lighting systems and hot water systems plays an important role in energy efficiency in the services sector.

In the industry, depending on the conditions of the mathematical optimization problem, 71% reduction in power consumption can be achieved by modernizing of the metallurgy sector. However, the share of other sectors may be larger than during the real implementation of energy saving policy in the industry.

In the transport sector, during the implementation of energy saving policy considerable attention should be given to road transport (cars and trucks) that can provide 65% contribution to reduction in the total energy consumption by this sector.

Estimate of the volume of necessary investments

The energy savings expected from the implementation of the recommended actions as well as the assessment of relevant investment needs are presented in Table 8.

Table 8. Measures implementation of the National plan

No.	Economic sector, where the measures will be implemented	Expected savings in 2017, ktoe	Expected savings in 2020, ktoe	Responsible agency	Total funding from 2015 to 2020, EUR mil
1.	Households	2160	3226	Minregion	11 170
2.	Services	598	1041	SAEE	4 980
3.	Industry*	581	1610	Ministry of Economic Development and Trade	4 265
4.	Transport	274	624	Ministry of Infrastructure	14 655
Total		3613	6 501		35 070

* The industry includes agriculture

The greatest impact of public investment will have on the household sector and the services sector, while industry and transport investment are predominantly private consumer.

The main sources of implementation of the National plan will be:

- investments from Energy Efficiency Fund;
- funds of international financial organizations and international technical assistance projects;
- funds of ESCO's companies (performers of energy service agreements);
- private investment of the beneficiaries themselves;
- others sources.

Important is the stability of filling the Energy Efficiency Fund. It is proposed to apply the approach with revolving mechanism of filling the Fund – savings through implementation of energy efficient activities can be partially aimed at further support of energy efficiency projects through the Fund.

The introduction of new approaches to implementation of the state policy on energy efficiency financing is an essential requirement for attracting funds from international financial institutions and donor support to finance energy efficiency in Ukraine.

1.5. Assessment and monitoring of energy savings according to the Directive

The assessment of energy savings (both by sectors and by energy types) by “bottom-up” modeling sector has to be made on the basis of recommended standard methodology according to the list of recommended measures on improving energy efficiency. Assessment should be based on official statistical data.

Monitoring in the framework of this Plan will be conducted annually on the basis of the data from national statistical energy balances.

Monitoring by “bottom-up” modelling is not foreseen in the framework of this Plan.

While measuring the achieved energy savings as stated in Article 4 of the Directive and determining the cumulative improvement of energy savings and impact of individual activities, to assess the annual gain in energy savings is used the harmonized calculation model, which combines a number of ascending (bottom-up) and descending (top-down) methods of calculation.

CHAPTER II

Description of final energy consumption by sectors, assessment of energy efficiency improvement mechanisms and instruments

2.1. Households

As of 1 January 2014, Ukraine's housing stock comprised 1096.6 M m² of total floor area, including urban housing resource of 700.1 M m² (63,8%) and rural housing stock of 396.5 M m² (36.2%). Nearly the entire housing resource, specifically, 98.2% of the total floor area, consisted of apartment houses. Specific share of hostels and non-residential buildings in the housing resource makes up mere 1.8%. The total number of apartments in Ukraine was 19.368 M, i.e. 23.8 m² per citizen on average.

According to 2013 Energy Balance of Ukraine, the energy consumption by residential sector totaled 23.495 Mtoe, that makes nearly 33.78% of the overall final energy consumption in 2013. In 2008, energy consumption in residential sector totaled 22.845 Mtoe (Figures 8 and 9).

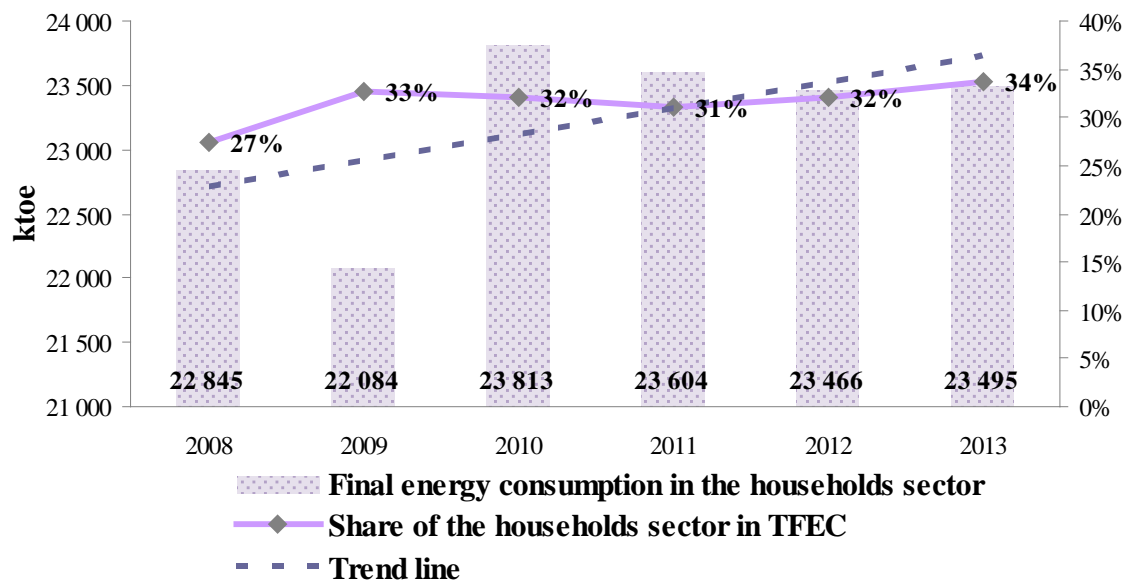


Figure 8. Dynamics of the final energy consumption in households

As the energy balance data demonstrates, for the recent 6 years the final consumption by the households has been stable, with the share of residential sector being the highest in the final energy consumption.

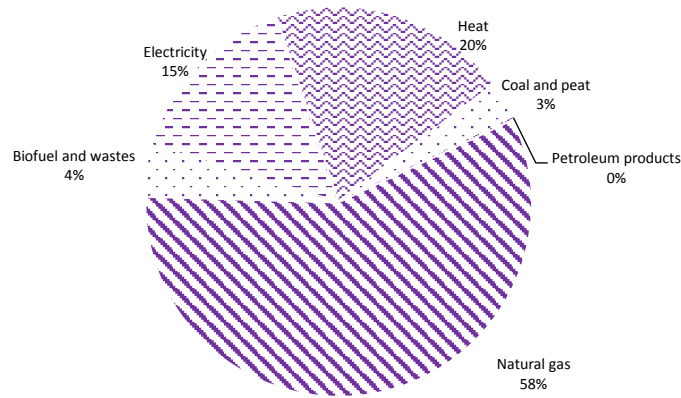


Figure 9. Structure of final energy consumption in residential sector by fuel types in 2013

Natural gas consumption has been permanently demonstrating the biggest share (58%) in the household energy consumption. However, it is worth noting that the natural gas consumption by the households and the district heating utilities supplying heat to households decreased in 2014 as compared to 2013 by 11% and 15 %, respectively (Figure 10).

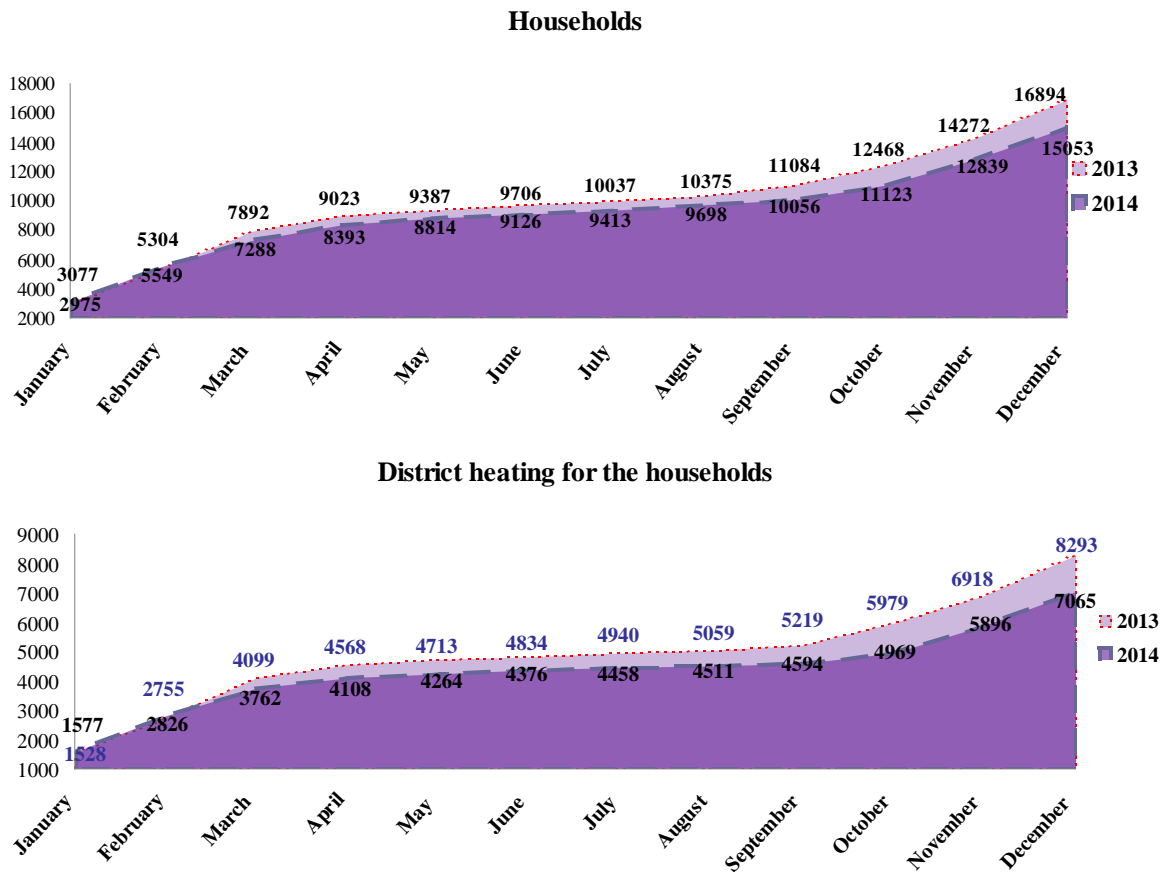


Figure 10. Natural gas consumption by population
in 2013-2014 ml m³ (cumulative)

The most of residential houses in Ukraine had been constructed before 1970 (61%). Given the above, the energy efficiency improvement measures applied to the residential sector are oriented to:

increase energy performance of the buildings and replace the existing equipment with more energy efficient equipment (insulation of external walls and roofs with appropriate insulation materials, replacement of windows, modernization of lighting systems, etc.);

raise awareness of owners and tenants about the opportunities and cost-effectiveness of energy saving by using energy efficient materials and systems and nurturing energy efficient behavior.

For residential sector, the energy efficiency measures include introduction of complete energy metering, introduction of stricter building codes (in particular, annually growing number of new nearly zero-energy buildings), introduction of auditing and certification schemes for households, introduction of labelling and indicating energy consumption information on all energy consuming household appliances, introduction of minimum energy efficiency standards, financial support to households for the implementation of energy efficiency upgrade interventions in their homes, awareness campaigns promoting low-cost energy savings through the changes in energy consumers' behavior and larger-scale actions.

A more detailed description of the above measures along with the description of the existing programs and energy efficiency improvement actions in residential sector (households) is represented in Table 9.

Table 9. Description of individual EEI measures in the residential sector (households)

Name of the program/measure	Category	Geographical coverage	Target group	Aim of measure	Impact	Annual energy savings expected in 2017/2020, ktoe	Implementation period
Thermal modernization of residential buildings via cheaper loans (easy-term loans, reimbursement of the principal amount of or interests on the loan, issuing of guarantees)	Energy services/Financial instruments (Subsidies)	National	Owners and co-owners of houses – taking measures in one-family and apartment houses, individual apartments in blocks of flats	To have energy consumption reduced (utilities services and energy carriers) in residential houses. Preventing “energy poverty” (so that utilities services and electricity bills do not exceed 10% of household incomes) while bringing the tariffs and prices of utilities services and energy resources up to the	Launch of governmental promotion of EEI measures, in particular, integrated thermal modernization, via co-financing (reimbursement of the portion of loans, partial compensation of interests on the loans engaged for implementation of this measure). Stable governmental financial support to thermal modernization of residential	529-880	2015-2020

Name of the program/measure	Category	Geographical coverage	Target group	Aim of measure	Impact	Annual energy savings expected in 2017/2020, ktoe	Implementation period
Complete metering of energy consumption and informative billing, where the bills offer analytical data on energy consumption dynamics (utilities services)	Dissemination of information and conducting mandatory public events	—“—	Final energy consumers, holders of natural monopolies and economic entities on related markets	economically justified level. Launching complete energy metering in residential sector (households)	buildings, in particular, via establishing of the Energy Efficiency Fund, fund raising from international financial institutions and donor organizations. Launching complete metering of cold and hot water, natural gas, heat and informative billing based on actual data of individual consumption. Informative billing is the adaptation to reflect, in	694-788	Partly implemented (in the part of gas and electricity supply); needs implementation of the mandatory commercial register in the spheres of heat supply, central water supply and drainage system, delivery of

Name of the program/measure	Category	Geographical coverage	Target group	Aim of measure	Impact	Annual energy savings expected in 2017/2020, ktoe	Implementation period
Review of building codes and standards	Regulatory act	—“—	Developers and owners (co-owners) of housing resource	Increased use of energy efficient materials, equipment and technologies	<p>particular, general consumption trends of the previous periods. Public disclosure of the structural components of the utilities tariffs and prices.</p> <p>Due to rather long lifecycle of the buildings – the energy efficiency of new buildings is a solution to the problem of fuel and energy overconsumption in residential sector in the long term. The minimum requirements will be launched and applicable to the</p>	294-408	<p>utilities services. Implementation period is 2016-2019.</p> <p>The Law of Ukraine “On Energy Performance of the Buildings” and relevant subordinate legislative and regulatory acts should be adopted – 2015-2020.</p>

Name of the program/measure	Category	Geographical coverage	Target group	Aim of measure	Impact	Annual energy savings expected in 2017/2020, ktoe	Implementation period
					<p>energy performance of new buildings and the old buildings, which are subject to overhaul. Minimum requirements to energy performance of buildings shall be subject to review once during five years by the central executive authorities responsible for making and implementing of the governmental policy in the area of construction, architecture, city planning</p>		

Name of the program/measure	Category	Geographical coverage	Target group	Aim of measure	Impact	Annual energy savings expected in 2017/2020, ktoe	Implementation period
Launching certification of energy performance of buildings	Awareness campaigns/Regulatory act	—“—	Works/service providers for energy efficiency of buildings	To get information about actual and/or estimated energy performance indicators of the buildings, findings of assessment of their compliance with the minimum requirements to energy performance of buildings and to drafting recommendations on cost-efficient improvement of energy performance of the buildings	An energy performance certificate provides comprehensive information on energy characteristics of the buildings, recommendations on cost-effective decisions. It is necessary to ensure creation of relevant databases containing the energy performance certificate details and provide public access to them to all stakeholders.	204-293	The Law of Ukraine “On Energy Performance of the Buildings”, which implementing Directive 2010/31/EU on the energy performance of buildings, should be adopted The system of building energy performance certification to be in full operation by

2.2. Services

The buildings in the commercial and public sectors (offices, administration premises, educational institutions, health care institutions, trade outlets, hotels, warehouses, etc.) built mainly before 1990 fall into the services sector. In terms of energy efficiency, most of them need major overhaul and renovation, because their traditional architectural design and the equipment, materials and systems (large-panel, large-block, frames made of precast concrete, etc.), do not meet up-to-date energy efficiency requirements, and therefore are characterized by low energy-saving properties.

Total number of budget-funded institutions in Ukraine makes up nearly 100 thousand including:

- 22 thousand comprehensive schools;
- 24 thousand permanent pre-school institutions;
- 24 thousand cultural establishment of club type;
- 225 museums;
- nearly 4 thousand hospitals, etc.

In 2005, total final energy consumption in the services sector (both commercial and public buildings) amounted to 4.71 Mtoe, that makes 5.69% of TFEC in Ukraine (Figure 11).

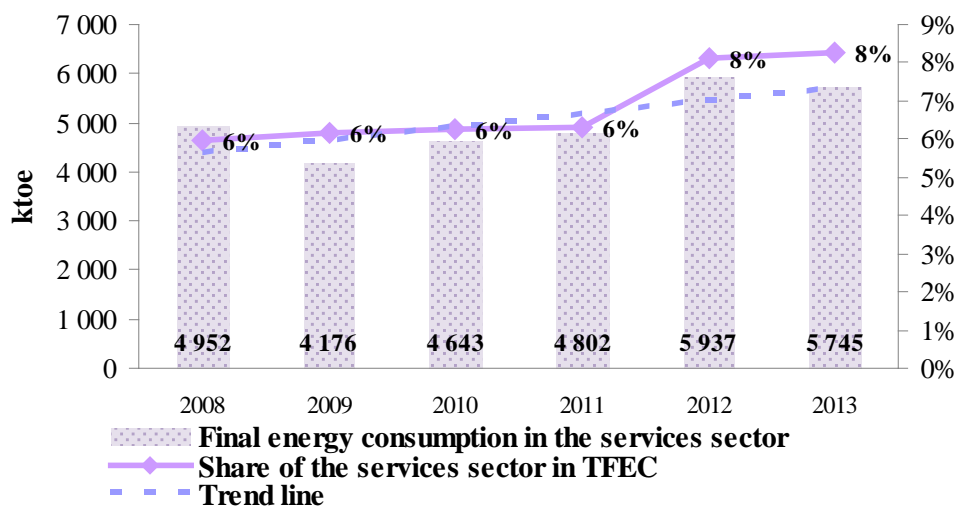


Figure 11. Dynamics of final energy consumption in the services sector

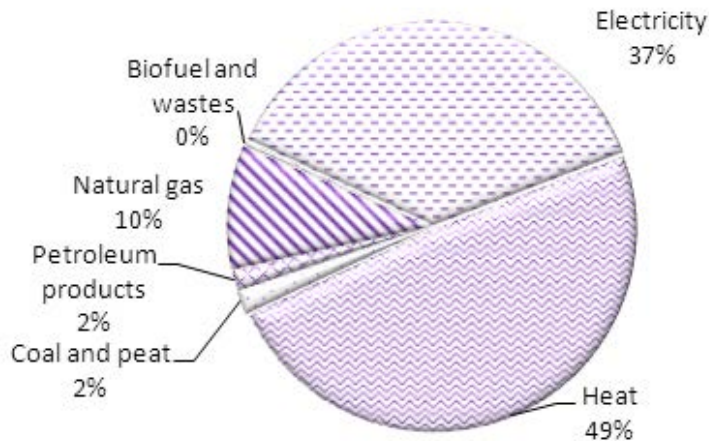


Figure 12. Structure of final energy consumption in the services sector by fuel types in 2013

As we can see on Figure 2.5, the major fuel types in final consumption in the services sector are heat and electricity.

Natural gas accounts for 10% in the final energy consumption. It is worth noting that its consumption in the services sector in 2014 decreased nearly by 22% as compared to 2013 (Figure 12).

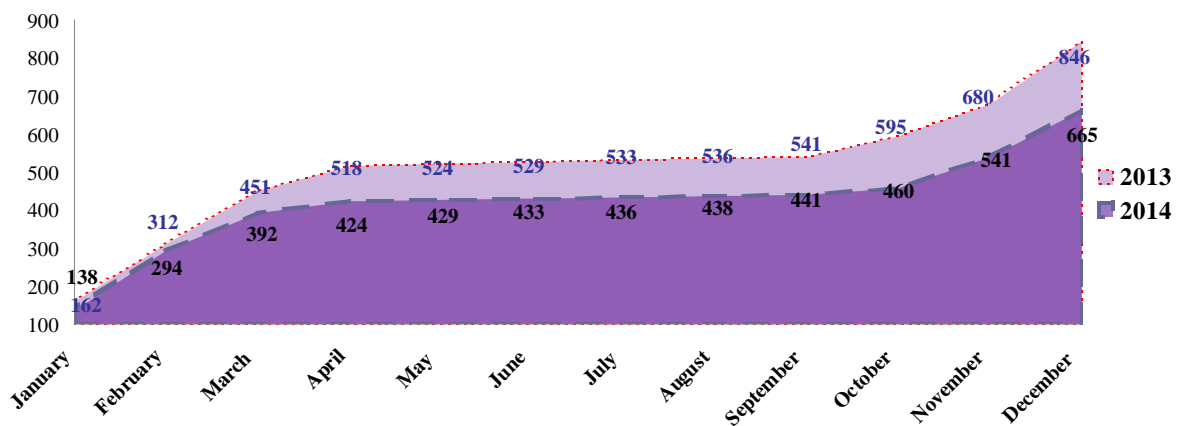


Figure 12. Natural gas consumption directly by budget-funded institutions and organizations in 2013 and 2014, million m³ (cumulative)

Inefficient activities of the local authorities concerning the improvement of energy efficiency of buildings in the public sector (schools, hospitals, administrative buildings, etc.) has resulted in consistently high volumes of thermal energy consumption (with more than 30% of heat lost), at the same time they do not provide thermal comfort for their users.

As a first step towards eliminating energy losses, the legislation stipulates to equip all public buildings in the nearest future with heat meters (by means of

registration and regulation), via including the relevant costs in the heat rates or via special budget programs that will enable substantial heat savings (and, accordingly, savings of the budget funds), however, to do so, municipalities will have to implement certain considerable energy-saving interventions including modernization of district heating systems and thermal modernization of public buildings (efficient insulation of external walls and roofs, replacement of energy inefficient glazing with efficient ones).

Implementation of energy saving programs in the services sector is fully in accordance with the EU policy and the country's commitments to transpose the EU Directives.

The implementation of relevant EEI measures in Ukraine will facilitate energy efficiency improvement in the services sector and assure an exemplary role of the public sector.

The above policy measures include, introduction of commercial energy metering and billing, introduction of building codes, engagement of ESCOs in implementing of energy efficiency projects, certification schemes for public buildings. Strong efforts should also be put to achieve large energy savings at low cost, such as encouraging the changes in behavior through education, training and awareness campaigns.

For more detailed description of the above measures, energy efficiency improvement programs and measures in the services sector see Table10

Figure 10. Description of individual EEI measures in the services sector

Name of program/measure	Category	Geographical coverage	Target group	Aim of the measure	Impact	Expected annual energy savings in 2014-2020, ktoe	Implementation period
Thermal modernization of buildings of budget-funded institutions and organizations via energy performance contracting	Energy services/Financial instrument	National/local	Energy service providers, budget holders responsible for operative administration of the buildings	To reduce energy consumption (utility services and energy) in public buildings. To ensure capacity of the budgets at any level to fund maintenance of public buildings	Legislative framework for energy performance contracting with respect to public buildings shall be in place, in particular, the terminology related to energy services and essential conditions of energy performance contracts shall be defined, relations shall be legislated between energy service customers and providers, budget-funded institutions shall be provided the opportunity to enter into energy service contracts for periods longer than 1 year, long-term guarantees for investors shall be ensured, in particular, payment of remuneration for the savings	99-374	2015-2020

Name of program/measure	Category	Geographical coverage	Target group	Aim of the measure	Impact	Expected annual energy savings in 2014-2020, ktoe	Implementation period
Complete metering of energy consumption and informative billing, where the bills offer analytical data on energy consumption dynamics (utilities services)	Regulatory act/Awareness campaigns	National	Final energy consumers, budget holders responsible for operative administration of the buildings, holders of natural monopolies and economic entities on related markets	To encourage owners and tenants of services sector facilities to introduce energy efficient equipment and technologies	Energy consumption metering system with individual meters in combination with transparent energy bills will encourage the owners and tenants to improve energy efficiency. Energy bills may include the data on energy consumption during the year, and also comparison of that data with those from previous years. Besides, it is necessary to indicate potential energy saving as the result of EE measures implementation	194-206	Lauching of mandatory metering of district heating, centralized water supply and water drainage. Implementation period: 2016-2019.

Name of program/measure	Category	Geographical coverage	Target group	Aim of the measure	Impact	Expected annual energy savings in 2014-2020, ktoe	Implementation period
Review of building codes and standards	Regulation	National	Developers, structural engineers, designers of buildings, owners and consumers from the residential sector and services sector	Increase in the use of energy efficient materials and technologies	Standardization is very important for energy efficiency in Ukraine to form the set of essential rules, norms, requirements of efficient use and saving of fuel and energy. Energy efficiency standards are also the basis for imposing economic sanctions on inefficient energy consumers and manufacturers of inefficient equipment and materials. Minimum energy consumption norms (normalization of energy consumption) are the standards applicable to equipment and appliances which consume electricity, such as: household appliances, office equipment, transformers, electric motors and equipment for heating,	35-53	The Law of Ukraine “On Energy Performance of the Buildings” and relevant subordinate legislative and regulatory acts should be adopted. Implementation period: 2015-2020.

Name of program/measure	Category	Geographical coverage	Target group	Aim of the measure	Impact	Expected annual energy savings in 2014-2020, ktoe	Implementation period
					<p>ventilation and air conditioning.</p> <p>An energy performance certificate shall be issued by a special authorized central executive body responsible for implementation of the governmental policy in the area of efficient use of energy. The certificate shall prove the energy savings declared by an economic entity resulting from the implemented energy efficiency measures.</p> <p>Improved processes of electricity consumption monitoring as well as the demonstration of this process in the energy bill will be of crucial importance for realistic assessment of electricity losses due to technological and other reasons, thus bringing about</p>		

Name of program/measure	Category	Geographical coverage	Target group	Aim of the measure	Impact	Expected annual energy savings in 2014-2020, ktoe	Implementation period
-------------------------	----------	-----------------------	--------------	--------------------	--------	---	-----------------------

actual efficiency of the energy saving measures, and establishing incentives for further energy efficiency improvement.

And, minimum requirements shall apply to energy efficiency of new buildings and existing buildings, which are subject to overhaul.

Minimum requirements to energy performance of buildings shall be reviewed every five years by the central executive authority in charge of making and implementation of the building, architecture and town planning policies.

Name of program/measure	Category	Geographical coverage	Target group	Aim of the measure	Impact	Expected annual energy savings in 2014-2020, ktoe	Implementation period
Launching certification of energy performance of buildings	Information and mandatory awareness events	—“—	Developers, structural engineers, designers of buildings, owners and consumers from the residential sector and services sector	Better awareness of electricity consumption in the buildings resulting in higher energy efficiency	The certification of buildings in terms of their energy performance is a very important measure for the promotion of energy efficiency concept among building developers, designers, structure engineers, owners and users. An energy certificate is a document that provides comprehensive information on the energy performance of buildings and recommendations on cost-effective solutions for improvements of their energy consumption, increases the awareness of owners about cost-effectiveness of energy efficient behavior and technical solutions and encourage them to easier decide and implement energy-saving measures. On the other hand, as a document that “accompanies” all the transactions related to buildings (renting, selling etc), it brings an added value	23-45	Energy certification of residential and public buildings has been carried out in Ukraine since 01.04.2007, when the state building code DBN V.2.6-31:2006 “Thermal Insulation of Buildings” was introduced. Energy certification of building had been optional before 2009. On 01.07.2008, the state

Name of program/measure	Category	Geographical coverage	Target group	Aim of the measure	Impact	Expected annual energy savings in 2014-2020, ktoe	Implementation period
Incorporating energy efficiency criteria in public procurement procedures.	Regulatory act	National/local	Civil servants	Increased share of energy efficient appliances, materials and equipment in budget-funded institutions	Amending the public procurement legislation and setting energy efficiency criteria for bidders in public procurement tendering procedures.	103-146	Amendments to the Law "On Public Procurement" are planned for 2016.

2.3. Industry

The share of industry in Ukraine's FEC is significant. During 2005-2008, this share ranged between 45 and 47% and only in 2009, it has decreased nearly to 41% due to the global financial crisis (see Figure 13).

During 2005-2009, the average annual gas consumption in the industry amounted to 11.1 billion m³, that of electricity was 66.7 billion kWh, that of coal – nearly 12.6 million tons. The share of renewable energy sources, as with other sectors, is very small, while the potential is rather high, only industrial waste, solar and geothermal energy could be efficiently used (see Figure 14).

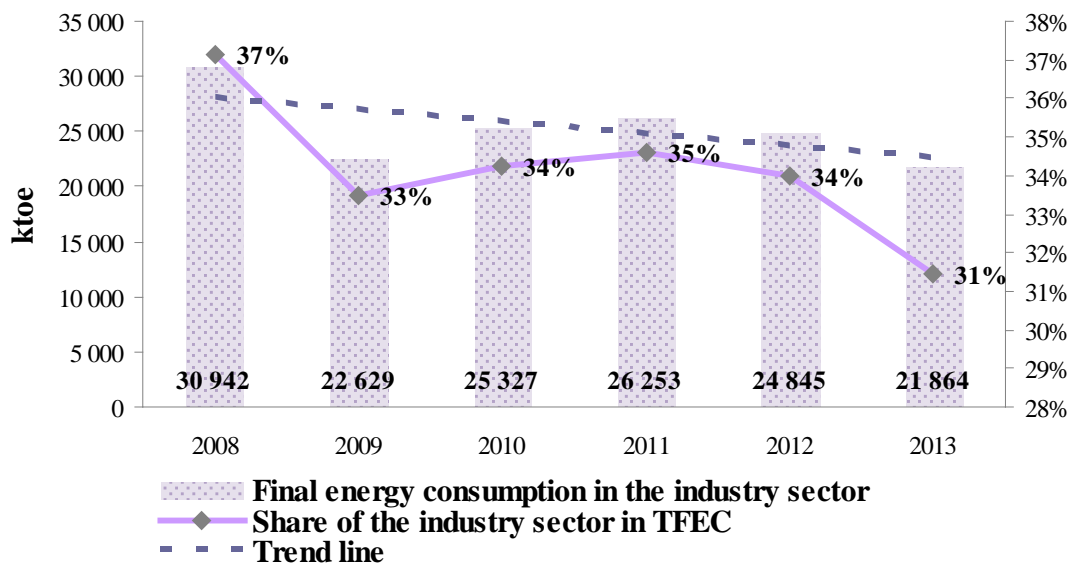


Figure 13. Dynamics of final energy consumption in industry

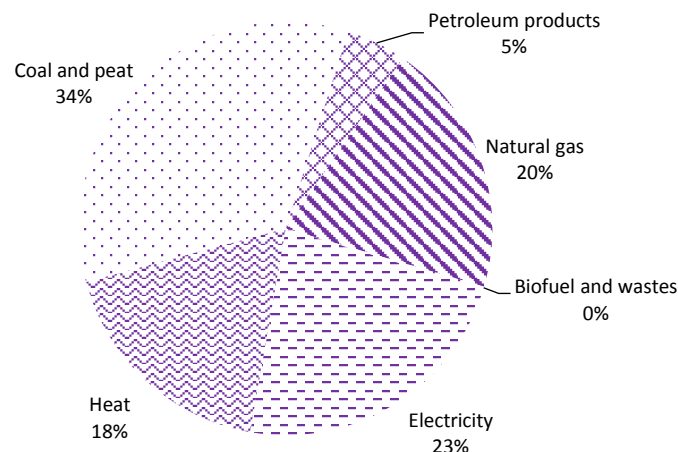


Figure 14. Structure of final energy consumption in industry by fuel types in 2013

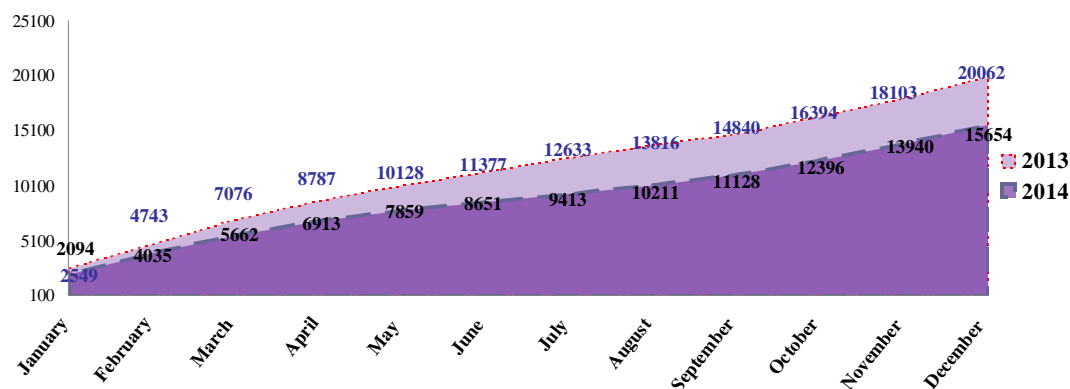


Figure 15. Natural gas consumption by industrial consumers in 2013 and 2014, million m³ (cumulative)

Natural gas plays an important role in the industrial production. However, we should mention that due to the decrease in the industrial output, the industry consumed 22% less gas in 2014 than in 2013 (see Figure 15).

The most energy-intensive industries in Ukraine are mining and metallurgy, chemical industry, cement production and machine building. The energy intensity of production in those sectors is significantly higher than in the leading global companies, particularly, in EU countries.

For example, in the first half of 2011, the energy intensity of cast iron production was almost 33% higher in Ukraine than in the EU and the energy intensity of steel production was 55% higher than in the EU. In chemical industry, the actual energy consumption at most local chemical plants in absolute terms is 1.3 to 3 times higher than the consumption at comparable plants where state-of-the-art technologies are applied.

This situation mainly is attributable to the fact that Ukraine's industrial infrastructure is characterized by inefficient, in terms of energy, resource intensive and environmentally unfriendly equipment, in most cases even with expired lifetime. Ukraine still lags behind in the use of state-of-the-art industrial technologies, and thus is consuming more fuel per unit of industrial output. This situation maybe did not have economic impact in the past when energy prices were state-controlled, but currently, with imported natural gas (which price significantly increased in 2008) playing a dominant role in industrial production, this situation leads to increasing production costs, decreasing competitiveness of Ukrainian products and loss of a significant share of domestic and export markets.

Therefore, priority measures for Ukrainian industry are engagement of ESCOs, labeling and marking standard information about the energy and other resource consumption for production of energy-intensive goods, implementation of energy audit and energy management schemes in industries, introduction of minimum standards for industrial equipment, focused information campaigns for raising awareness of industrial manufacturers to unlock the energy savings potential in industry.

For more details of the above measures along with the description of the ongoing energy efficiency programs and measures in industry see Table 11.

Table 11. Description of individual EEI measures in the industry sector

Name of program/measure	Category	Geographical coverage	Target group	Aim of the measure	Impact	Expected annual energy savings in 2014-2020, ktoe	Implementation period
Implementation of energy efficiency measures via energy service contracting with respect to industrial facilities	Energy services/Financial instrument	National	Final consumers	Increased share of energy efficient technologies and equipment	<p>As a result of an energy service contract between an enterprise owner and an energy service company (ESCO), the latter should carry out examination, metering, and on this basis to provide a real picture of the condition of enterprise's energy systems.</p> <p>Upon analysis of the situation, potential energy saving measures shall be developed for the enterprise, economic analysis of potential risks shall be conducted.</p> <p>Findings of the ESCO's energy audit shall be documented in a special report in a form of a business plan. This report is intended for managerial decision-making for defining investment priorities among potential rival projects of business</p>	216-625	2016-2020

Name of program/measure	Category	Geographical coverage	Target group	Aim of the measure	Impact	Expected annual energy savings in 2014-2020, ktoe	Implementation period
Launching of energy audit and energy management systems	Awareness campaigns and mandatory information measures	—“—	All industrial enterprises in the scope of the Directive – mostly	All energy efficiency improvement measures relating to all industrial processes	<p>development.</p> <p>Another important detail is in the scope of this energy service company operation defines the impact of the developed energy-saving opportunities on environment.</p> <p>This report may become a good support to the enterprise owner in drafting the enterprise’s development program, the introduction of efficient, optimum and really fruitful energy-saving measures, attraction of third party (borrowed) funds. And, ESCO may deliver support in the implementation of energy efficiency measures and monitoring thereof.</p> <p>In accordance with the Directive, the Member-Countries guarantee efficient, high-quality schemes of energy consumption examination for all final consumers, including small household, commercial</p>	68–191	—“—

Name of program/measure	Category	Geographical coverage	Target group	Aim of the measure	Impact	Expected annual energy savings in 2014-2020, ktoe	Implementation period
			industrial small and medium enterprises		and small and medium industrial consumers. Energy audit at industrial enterprises may include: - mandatory audits for the companies, which annual energy consumption exceeds the set energy consumption value - voluntary audit scheme for other companies		

2.4. Transport

The transport sector accounts for about 17.5% of the final energy consumption, and its share has been steadily growing as the annual growth rate of final consumption in the sector was over 4% in the recent five years (Figure 16). The main contributor to this increase in the share of the final consumption is the road transport, which accounts for over 90% of the total energy consumption in the sector.

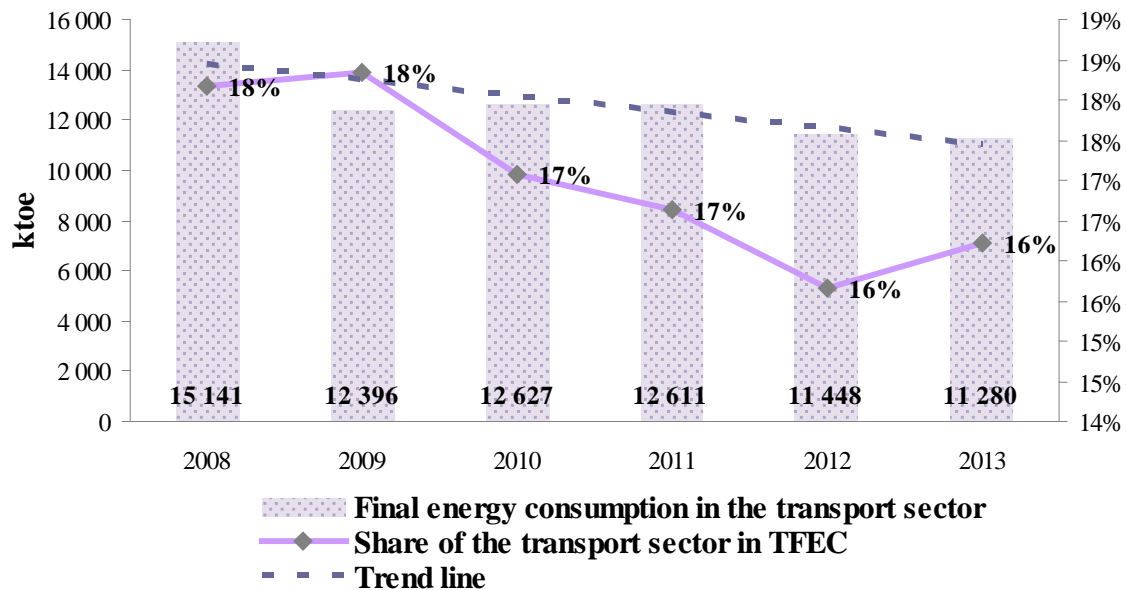


Figure 16. Dynamics of the final consumption in the transport sector

Due to the global financial crisis and economic processes in Ukraine in 2008-2011 has been a steady tendency to reduction of volumes of transportations by all types of transport of goods (excluding road transport) and passengers (except aviation), which resulted in a reduction of fuel usage in the transport sector of Ukraine (Table 12).

Table 12. Transportation of goods and passengers by means of transport

Year	2007	2008	2009	2010	2011	2012
M t						
All transported goods:	708	704	541	602	657	644
Railway	514	499	391	433	469	458
Water	24	19	10	11	10	9
Automobile	0,1	0,1	0,1	0,1	0,1	0,1

	M of passengers						
All transported passengers:	8214	8331	7275	6845	6980	6812	
Railway	447	445	426	427	430	427	
Water	10	9	8	8	8	7	
Automobile	4173	4369	4014	3726	3612	3449	
Aviation	5	6	5	6	8	8	
Trolleybus	1621	1580	1283	1204	1346	1346	
Tram	1027	963	787	714	798	800	
Subway	931	959	752	760	778	774	

The main types of fuel consumed by road transport are, in particular, gasoline and diesel fuel (Figure 17). The share of diesel in the consumption during 2000-2010 increased from 28.5% of the total fuel consumption by the road transport in 2000 to 37.6% in 2010. Meanwhile, the consumption of LPG (propane-butane) increased more than fourfold during the last decade, and the consumption of compressed natural gas (CNG) grew almost three times. This can be attributed to a faster growth in the prices for traditional types of motor fuels.

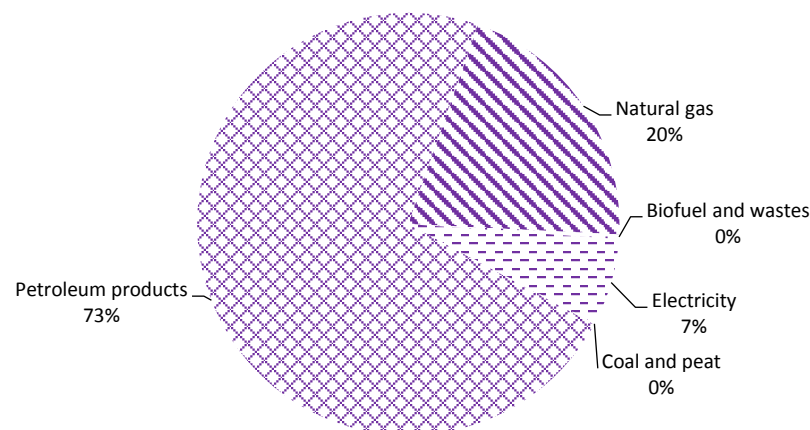


Figure 17. Structure of final energy consumption in transport by fuel types in 2013

Automobile transport is the main consumer of motor fuels of oil origin. To transport the same cargo vehicles need in 6.5 times more fuel than rail, and 5 times – than in water.

The private sector of public transport in Ukraine is characterized by a significant number of so-called "taxi minibuses", which in most cases replace

large buses, trams and trolleybuses. Under these conditions, one passenger-kilometer occurs more consumption of fuel, because a taxi contained significantly fewer people than in a big bus.

At the beginning of 2011 the car Park of Ukraine numbered 9.5 million units, including 6.8 million passenger cars, 1.2 million trucks and about 0.2 million buses, the rest of the motorcycles and trailers.

Thus, the policy in the field of energy efficiency in the transport sector will focus on automobile transport.

The main priorities of energy efficiency in transport, which will be implemented in the framework of the relevant activities, including: the development of the market for cleaner, more energy-efficient and safe vehicles (through incentives such as easier access to city centres by public transport, creation of parking systems, optimization schemes, public transport, etc), improving the efficiency of state management in the industry, the development of transport infrastructure, rolling stock renewal, integration of the national transport system with the European and international transport systems.

A more detailed description of the above activities with a description of existing programs and activities to improve energy efficiency in the transport sector are presented in Table 13.

Table 13. Description of individual EEI measures in the transport sector

Name of program/measure	Category	Geographical coverage	Target group	Aim of the measure	Impact	Expected annual energy savings in 2014-2020, ktoe	Implementation period
Optimizing the structure of passenger and freight traffic in cities	Awareness campaigns	Local	Final consumers	Decrease of fuel consumption in transport sector (while passenger and freight transportation)	Creating more zones (in cities) forbidding to use private transport, launching paid parking lots. Introduction of schemes and modes of passenger and freight transport services that would help consume less fuel. Introduction of new technologies of transport services, logistics, navigation, communication and information.	72-170	2016-2020
Adaptation of fuel standards and its technologies of use to European standards	Regulatory acts	National		Reduced consumption of fuel in the sector (while passenger and freight transportation)	Regular review and harmonizing of standards (technical regulations) of fuel in transport sector with EU regulatory acts	53-115	—“—

Name of program/measure	Category	Geographical coverage	Target group	Aim of the measure	Impact	Expected annual energy savings in 2014-2020, ktoe	Implementation period
Public transport fleet renovation.	Financial instruments	Local	—“—	Reduced consumption of fuel and energy by public transport	Renovation of the buses and city electric transport. Increasing the share of public electric transport with high efficiency of fuel and energy consumption	35-92	—“—
Private transport fleet renovation.	—“—	—“—	—“—	Reduced consumption of fuel and energy by private transport	Increasing the share of private electric transport with high efficiency of fuel and energy consumption	99-218	—“—
Advertising of use of bicycles and conducting Car-free days	Information campaigns	National/local	—“—	Reduced consumption of fuel by transport	Raising public awareness of the owners of vehicles on advantages of the limited use of private transport and on the use of bicycles and increase of their use	10-20	—“—

CHAPTER III
Horizontal and Cross-Sectoral Measures

3.1. List and Description of Horizontal and Cross-Sectoral Measures

Tables 14 and 15 provide an overview of all horizontal and cross-sectoral measures and the sectors they impact.

Table 14. Horizontal and cross-sectoral measures

№	Measures	Household sector	Service sector	Industry sector	Transport sector
1.	Conducting awareness and promotion programs of economic, environmental and social benefits of the efficient use of fuel and energy, and implementation of measures on energy saving	✓	✓	✓	✓
2.	The establishment of minimum energy efficiency requirements for buildings and equipment; the operation of a system of energy labelling of electrical household goods	✓	✓	✓	
3.	Ensuring complete metering of energy consumption of natural gas, heat and water, and informative billing of consumed energy with analytical data on dynamics of energy and utility services consumption	✓	✓		
4.	Introduction of energy audits and energy management systems	✓	✓	✓	

Table 15. Horizontal and cross-sectoral measures

Name of program/measure	Category	Level of implementation	Target group	Aim of measure	Impact	Expected annual energy savings in 2020	Implementation period
Conducting awareness and promotion measures of economic, environmental and social benefits of the efficient use of fuel and energy, and implementation of measures on energy efficiency	Informative measures	National	All end-users (household sector, the service sector and transport)	Raising awareness on efficiency of energy use and increase of energy efficiency by achieve behavioral changes of consumers regarding energy consumption	Raising awareness in energy consumers on energy efficiency. Forming energy efficient behaviour in end-users by implementation of certain educational programs in educational institutions	202 ktoe (Saving potential in 2017- 82 ktoe)	Always
The establishment of minimum energy efficiency requirements for buildings and equipment; the operation of a system of energy labelling of electrical household goods	Normative act/Informative activities	—“—	The owners (co-owners) of housing, the property owners and tenants, end-users	The increase in the share of energy efficient technologies and equipment, the promotion to the acquisition of household energy products with more efficient energy efficiency class	Improving consumer awareness on energy efficiency in buildings, technical equipment and appliances. Introduction of energy labeling also encourage industry to produce energy efficient products.	The potential energy savings of this measure is estimated at 192 ktoe - in the services sector, 690 ktoe - in residential sector, 794 ktoe - in the industrial sector.	2015-2020
Other horizontal and cross-sectoral activities described in Chapter II separately for each sector.							

3.2. Assessment of Horizontal Measures

By this time in Ukraine introduced a significant number of EU regulations. They contain a wide range of activities and actions, including implementing measures of different standards and regulations on energy efficiency. Their effect can hardly estimate because of lack of methods and statistics. The effect of the above actions and the consequences could be assessed after the development of appropriate standards and procedures.

Prediction of final energy consumption is based on its dependence on gross domestic product (GDP). The State Statistics Service of Ukraine provided expected value of the average index of GDP for 2009-2020.

In fact, the observed increase in final energy consumption should slow down due to the implementation of energy efficiency measures. In the short and medium term, this dependence can be held constant: the growth rate of final energy consumption will be lower than GDP growth.

CHAPTER IV
Measures Specially Required by the Directive

4.1. Article 5 of the Directive on the Exemplary Role of the Public Sector in the Context of Energy Efficiency Improvement

Title	Relevant energy efficiency improvement measures	Title of the legislative act	Date of entry into force (expected)
Article 5, Annex 6-a of the Directive on amendments to the public procurement legislation.	Using of financial instruments to implement energy efficiency improvement measures for buildings of budget-funded institutions and organizations of public and communal ownership, including long-term energy service contracting.	Law of Ukraine № 327-VIII “On Introducing of New Investment Opportunities, Guaranteeing of Rights and Lawful Interests of Business Entities in order to Conduct Full-Scale Energy Modernization” of April 9, 2015.	2015
Article 5, Annex 6-b of the Directive on amendments to the public procurement legislation Article 5 of the Directive on measures to improve energy efficiency in the public sector pursuant to Article 13 (1) of the European Parliament and Council Directive 2010/31/EU dated 19 May 2010 on energy performance of buildings	Incorporating energy efficiency criteria in public procurement procedures Implementing a system of buildings certification, including buildings of budget-funded institutions and organizations. Mandatory placement of energy performance certificates (in buildings of state and municipal ownership with a total floor area over 500 m ² (from 1 January 2020 - over 250 m ²), in places accessible for the public.	Draft of regulatory act on incorporating energy efficiency criteria in public procurement Draft Law of Ukraine “On Energy Performance of Buildings”	2016 2016

4.2. Article 6 of the Directive on Obligations of Economic Entities Supplying Energy (Electricity, Natural Gas and Heat)

Title	Relevant energy efficiency improvement measures	Title of the legislative act	Date of entry into force (expected)
Article 6 (1) of the Directive on ensuring the key role of energy suppliers in fulfilment of the indicative target	Obligation of energy suppliers to: <ul style="list-style-type: none"> - facilitate and provide energy service and conduct energy audit (certification) of energy consumers; - provide, on regular basis, statistical information about their final consumers to the central body in charge of implementing the governmental policy in the area of efficient use of fuel and energy, energy saving; - ensure availability for their final users, advertising and facilitation in conducting of energy audits at affordable prices and/or conducting in an appropriate way of energy efficiency improvement measures; - facilitate financing of the mechanisms of energy efficiency improvement, efficient use of fuel and energy. 	Draft Law of Ukraine “On Efficient Use of Fuel and Energy”	2016

4.3. Article 7 on Information Availability

Title	Relevant energy efficiency improvement measures	Title of the legislative act	Date of entry into force (expected)
Article 7 of the Directive on transparency and wide-scale dissemination of information on energy efficiency improvement	To ensure information support, coverage and dissemination of information on energy efficiency improvement measures including about available financial and other instruments promoting the	Draft Law of Ukraine “On Efficient Use of Fuel and Energy”	2016

Title	Relevant energy efficiency improvement measures	Title of the legislative act	Date of entry into force (expected)
-------	---	------------------------------	-------------------------------------

mechanisms and approved financial and legislative frameworks for fulfilment of the national indicative target on energy saving implementation of such measures.

4.4. Article 12 on Energy Audits

Title	Relevant energy efficiency improvement measures	Title of the legislative act	Date of entry into force (expected)
Article 12 on energy audits	To ensure regulatory and institutional framework for creation and development of the energy audit and energy management systems	Draft Law of Ukraine “On Efficient Use of Fuel and Energy”	2016

CHAPTER V

Key Changes to the Legislation Related to the Implementation of the Directive

The table below lists relevant legislative and regulatory acts to be adopted to the end of implementing the Directive.

Title	Required changes	Description
The draft Law of Ukraine “On Energy Efficiency in Buildings” and the draft Law of Ukraine on efficient use of fuel	Replacement of the effective Law of Ukraine “On Energy Saving”, bringing the framework energy efficiency	Formalizing in legislation the lines, mechanisms and instruments of state policy implementation in the sphere of efficient use of fuel and energy, including creation of a

Title	Required changes	Description
and energy	legislation to compliance with the Directive and Directive 2010/31 /EU requirements	sound legislative framework for implementation of: - standardization and labeling systems; - energy audit and energy management systems; - buildings certification; - adoption of plans to increase the number nearly zero-energy buildings.
Developing of the Draft Law of Ukraine “On Commercial Metering in District Heating, Centralized Water Supply and Disposal, Utilities Services” (pursuant to Article 13 of Directive)	Ensuring complete commercial metering in the areas of district heating, centralized water supply and disposal, utilities services	Ensuring mandatory commercial metering in the areas of heating, centralized water supply and disposal, utilities services by defining: - deadlines, terms and conditions for commercial metering implementation; - sources of financing of the meter installation, maintenance and replacement works; - liability for breach of the law on commercial metering.
The Draft Law of Ukraine “On Amendments to the Law of Ukraine "on Natural Monopolies" (pursuant to article 10 of the Directive)	Cancelling the tariff approach “costs plus” for natural monopoly holders and business entities in adjacent markets. Transition to feed-in tariff regulation that will forecast incentives to decrease use/consumption of heat.	Adoption of the Draft Law will provide incentives for efficient use of water, fuel and energy. Setting of obligatory implementation of feed-in tariff regulation for natural monopoly holders in adjacent markets. Raising investment attraction of the sphere of energy efficiency technologies application. Introduction of economic incentives of the activity in the area of natural monopoly in related markets

Title	Required changes	Description
The draft resolution of the Cabinet of Ministry of Ukraine establishing the Energy Efficiency Fund (pursuant to article 11 of the Directive)	Creation of a transparent and stable instrument to finance the energy efficiency measures for residential buildings and buildings of budget-funded institutions and organizations buildings in the area of heating.	Approval of the Articles of the Energy Efficiency Fund, which: <ul style="list-style-type: none"> - determine the status of the Energy Efficiency Fund; - establish relevant management and control bodies, involving representatives of non-profit NGOs that work in the field of energy efficiency or international financial institutions and donors; - set a clear list of diversified and stable sources of funding; - set financial goals and objectives of funding the energy efficiency improvement measures in residential buildings, budget-funded institutions and organizations buildings, district heating facilities through co-financing.

Annex
to the National Energy Efficiency Plan
till 2020

Energy content/yield in specific types of fuel – conversion table

Product energy	kJ	kgoe (kg of oil equivalent)	kW/h
1 kg bituminous coal	21 688	0,518	6,024
1 kg lignite	8 528	0,204	2,369
1 kg crude oil	41 868	1,0	11,63
1 kg gas condensate	41 910	1,001	11,642
1 m ³ natural gas	33 704	0,805	9,362
1 kg peat	9 994	0,239	2,776
1 tight. m ³ wood heating	7 767	0,186	2,157
1 kg coke and semi-coke of coal, brown coal, peat	28 516	0,681	7,922
1 kg gasoline engine	43 668	1,043	12,130
1 kg diesel fuel	42 496	1,015	11,804
1 kg kerosene	43 082	1,029	11,967
1 kg fuel oil	40 151	0,959	11,153
1 kg propane, liquefied butane	46 013	1,099	12,781
1 kg ethylene, propylene, butylene, butadiene	43 668	1,043	12,130
1 kg vaseline, paraffin	43 357	1,036	12,043
1 kg peat briquettes	14 654	2,857	4,071
1 kg bitumen and oil shale	39 565	0,945	10,990
1 kg coke and oil shale	31 652	0,756	8,792
1 kg oils, greases	40 151	0,959	11,153
1 m ³ coal gas obtained by distillation in a coke ovens	16 753	0,400	4,649
1 m ³ blast furnace gas	4 279	9,785	1,189
1 kJ the resulting heat	1	0,024	0,278
1 kW/h electric power	3 600	0,086	1