Comprehensive assessment of the potential for efficient heating and cooling (HAC) in Albania

OVERVIEW OF HEATING AND COOLING REPORT FOR ALL PARTS I, II, III AND IV

Expertise France, on behalf of the Agence Française de Développement (AFD)

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Technical Assistance of AFD to MIE/Albania – 25 – MR1584

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[1] Un-occupied dwellings include newly constructed apartments (but not yet sold), touristically used dwellings and secondary residences.

List of Abbreviations

AFD	Agence Française de Développement
ALPEX	Albanian Power Exchange
BoQ	Bills of quantities
DCM	Decision of Council of Ministers
DG ENEST	Directorate-General for Enlargement and the Eastern Neighbourhood
EF	Expertise France
EFS	Environmental and Social Framework
EHS	Environmental, Health and Safety
EPC	Engineering, Procurement, and Construction
ERE	Energy Regulatory Entity
ESIA	Environmental and Social Impact Assessment
EUDA	European Union Delegation to Albania
FSHU	Furnizuesi i Sherbimit Universal / Last Service Supplier (part of OSHEE Holding)
GHG	Greenhouse gas
HPP	Hydropower Plant
HUPX	Hungarian Power Exchange
IFC	International Finance Corporation
IFI	International Financing Institution
IPCC	Intergovernmental Panel of Climate Change
IPP	Independent Power Producers
KESH	Albanian Energy Corporation
KfW	Kreditanstalt für Wiederaufbau
kV	kilo Volts
LGU	Local Government Unit
LTBRAP	Long Term Buildings Renovation Action Plan
MARD	Ministry of Agriculture and Rural Development
MECI	Ministry of Economy, Culture and Innovation
MHSP	Ministry of Health and Social Protection
MIE	Ministry of Infrastructure and Energy
MoTE	Ministry of Tourism and the Environment
NEA	National Environmental Agency
NECP	Energy and Climate Plan
NGOs	Non-Governmental Organisations
WBOP	World Bank Operational Policies
OPEX	Operating Expenses
OSHEE	Albania Distribution System Operator
OST	Albania System Transmission Operator
PFS	Pre-Feasibility Study
PV	Photovoltaic
PVPP	Photovoltaic Power Plant
RAPA	Regional Agency for Protected Area
REA	Regional Environmental Agency
SASPAC	State Agency for Strategic Programming and Aid Coordination
SCADA	Supervisory Control and Data Acquisition
TA	Technical Assistance
ToR	Terms of Reference
OST / TSO	Transmission System Operator
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
WACC	Weighted Average Cost of Capital
WAM	With Additional (EE&RES) Measures
WBIF	Western Balkans Investment Framework
WEM	With Existing (EE&RES) Measures
WPP	Wind Power Plant

SYNOPSIS

Project Title:	Comprehensive assessment of the potential for efficient heating and cooling (HAC) in Albania in full compliance with the requirements of the Energy Efficiency Directive (EU/2023/1791)
Project Number:	25 – MR1584
Contracting Authority:	Expertise France (EF), on behalf of the Agence Française de Développement (AFD)
Beneficiaries:	MIE/Albania
Contractor:	Energy Environmental Consulting Group shpk (EECG)
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Full Mobilisation of EECG team:	06 June 2025 (date of online Kick-off Meeting)
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1 Foreword

The Agence Française de Développement (AFD) has launched a program of Technical Assistance (TA) to support the Albanian Government in the energy sector reform. Expertise France (EF), the French public agency for international technical assistance, was entrusted by the AFD with the implementation of the project. As part of several commitments undertaken by the Government of Albania (GoA) in pursuit of its accession to the European Union, the country is engaged in an in-depth reform of its energy sector, including operational, financial, and structural aspects.

The Technical Assistance (TA) related to preparation of "comprehensive assessment of the potential for efficient heating and cooling (HAC) in Albania" aims in supporting the development of a modern legal framework with a focus placed on supporting the transposition of the EU acquis into the national energy sector legislation, being the priority of MIE. MIE has requested the above mentioned assessment to be a comprehensive assessment on efficient heating and cooling as required by the revised Energy Efficiency Directive (EU/2023/1791). Considering that the Electricity Generation in Albania is 100% renewable but the country also imports energy to meet its demand, decarbonizing the heating and cooling sector is central to achieving the energy transition. The process of replacing fossil fuels with renewables and other zero-carbon solutions in heating and cooling has been so far slow in Albania and this assessment is a first step to accelerate the development of renewables in this sector.

This final report presents and fulfil all requirements according to the ToR:

1. **Executive Summary**
2. **Part I - OVERVIEW OF HEATING AND COOLING Energy Demand and Supply for residential, public and private service sector as well as industry sector.**
3. **Part II - Objectives, Strategies and Policy Measures related to Heating and Cooling for different sectors;**
4. **Part III - Analysis of the Economic Potential for Efficiency in Heating and Cooling for different sectors; and**
5. **Part IV - Potential New Strategies and Policy Measures.**

2 Executive Summary

Albania's primary energy supply of 2,194 ktoe in 2023 is dominated by oil products (52.4% in 2023), hydro and net import electricity (31.7%), fuel wood (6.34%), coal (5.93%), natural gas (1.77%) and solar energy (through solar water heater system and PV systems (including Photovoltaic Independent Power Producers (PV IPPs) and PV Autoproducers) (1.6%)[2]. Final energy consumption – which is the total energy consumed by end users, such as dwellings/residential, public and private services, industry, transport and agriculture - is dominated by the transport sector, followed by residential, industry, service (which includes public building, private services and commercial buildings), agriculture and other sectors. The consumption of Albanian's building stock (including residential, public and the private building stock) amounts 33-34% out of the national total energy consumption, 65-75% of total electricity consumption and almost 75% of total electricity consumption for the year 2023[3]. The residential building sector it is the dominant consumer of electricity in Albania.

The Government of Albania has recognized the importance of the public sector playing an important role for defining proper policies through laws and secondary legislation related to Power Sector development, establishment of the ALPEX, Transmission Sector Investment Action Plan, Distribution Sector Investment Action Plan, Natural Gas development plan, EE (energy efficiency) and RES (renewable energy) action plans. To accelerate this progress, Albanian Government has passed the National Strategy of Energy (NSE), National Determined Contribution (revised NDC), 1st NEEAP, 2nd & 3rd NEEAP, Renewable Energy Sources (RES) Law, 1st and 2nd National Action Plan for Renewable Energy Sources (NAPRES), 2nd NAPRES, National Energy and Climate Action Plan (NECAP) (approved in December 2021 and actually revised and it will be approved soon by the

[2] Yearly Energy Balance for year 2023 prepared by AKBN/INSTAT
[3] Energy balances available here: http://www.instat.gov.al/en/themes/environment-and-energy/energy/#tab2

Albanian Government), Tariff System for retail customers and Feed in Tariff Scheme for all RES and Net Metering Scheme for PV and Wind Autoproducers (with installed capacity lower than 500 kW).

During the inception stage, collection and analysis of all available data was carried out. Consultant team reviewed all available documents based on the National Energy Strategy (2018), National Energy and Climate Plan (NECP) and using all official data based on the Yearly Energy Balances, Electricity Balances and Energy Surveys carried out by Energy Efficiency Agency supported by EECG, which contributed to the understanding of the subproject and technical factors.

Forecasting used bottom-up approach, relying on all final energy commodities consumption data across key sectors, residential, commercial/public buildings, industry for meeting space heating, space cooling, water heating (for building stock related to residential, public and private building sectors) and well as high temperature process heating, low heat process heating and process cooling (for industrial sector). Analysis carried out under the first part of this report presents a detailed estimate of the moderate increase in energy consumption for all above mentioned sector. EECG team used the excel spreadsheet model based on the same LEAP methodology taking into consideration base year energy consumption, share of fuels, energy intensity, population, number of buildings, areas of buildings and value added as main economic driver for calculating the demand for top important sectors (residential, public buildings, private buildings and industry) up to 2050. Energy consumption and forecasted demand for all sectors was carefully analysed and calculated for each sub-industrial sector since they are consuming very high amounts of electricity, heavy fuel oil, diesel, and firewood. Space heating, water heating and cooling energy demand is calculated for each of the following main scenarios:

- Baseline scenario is prepared based on the development trends according to the Strategy of Energy of Albania, NECP, LTBRAP for the above-mentioned sectors taking into consideration few EE measures for each energy service (this scenario is presented under Part I - included under this report);
- Active scenario: ii) efficient and RES heating and cooling supply scenario with much higher penetration compared with NECP-WAM (With Additional Measures) by introducing more efficient and renewable heating and cooling technologies (this scenario will be presented under Part III - Analysis of the Economic Potential for Efficiency in Heating and Cooling for different sectors).

Energy demand for the residential sector is forecasted to cover space heating, water heating, cooling (as well as lighting, cooking and electrical appliances) for three climatic zones for different reference building categories. Energy demand for the residential sector for baseline scenario will be respectively increased from 3,013 GWh/year (2023) to 3,873 GWh/year (2050) (for space heating), 698 GWh/year (2023) to 1,382 GWh/year (2050) (for space cooling) and 738 GWh/year (2023) to 1,114 GWh/year (2050) (for water heating). Also, useful energy was calculated based on the final energy forecasted values and weighted average efficiency of technical systems, for the residential sector, for baseline scenario and will be respectively increased from 2,481 GWh/year (2023) to 3,201 GWh/year (2050) (for heating), 636 GWh/year (2023) to 1,256 GWh/year (2050) (for cooling) and 674 GWh/year (2023) to 1,018 GWh/year (2050) (for water heating).

Public and commercial buildings in the service sector include schools, hospitals, administrative buildings, universities, hotels, restaurants, culture buildings, shops and all other commercial buildings. To increase the quality of the services and to improve the working conditions and comfort of all public central and municipal building sub-categories space heating, cooling water heating demand, for the baseline scenario was calculated. Energy demand for public building will be increased from 284 GWh/year (2023) to 360 GWh/year (2050) (for heating), 44 GWh/year (2023) to 104 GWh/year (2050) (for cooling) and 50 GWh/year (2023) to 75 GWh/year (2050) (for water heating). Useful energy was calculated and it will be increased from 220 GWh/year (2023) to 281 GWh/year (2050) (for heating), 39 GWh/year (2023) to 92 GWh/year (2050) (for cooling) and 45 GWh/year (2023) to 68 GWh/year (2050) (for water heating). Forecast energy demand for private and commercial buildings sub-sector for the space heating, cooling water heating demand will be respectively increased from 807 GWh/year (2023) to 1,260 GWh/year (2050) (for heating), 156 GWh/year (2023) to 435 GWh/year (2050) (for cooling) and 280 GWh/year (2023) to 524 GWh/year (2050) (for water heating). Also, useful energy was calculated and will be respectively increased from 691 GWh/year (2023) to 1,081 GWh/year (2050) (for heating), 140 GWh/year (2023) to 388 GWh/year (2050) (for cooling) and 253 GWh/year (2023) to 473 GWh/year (2050) (for water heating).

Consultant carried out the breakdown calculations on three important energy services for industrial sectors: 1) Low temperature process heating (LTH); 2) High temperature process heating (HTH) and 3) cooling (of industrial buildings for securing comfort and processes cooling for different industrial processes) and the respective final energy demand figures are respectively: 2,609 GWh/year (2023) to 4,026 GWh/year (2050) (for HTH), 942 GWh/year (2023) (for LTH) to 1,925 GWh/year (2050) and 83 GWh/year (2023) to 190 GWh/year (2050) (for cooling). Also, total industrial useful energy was calculated and will be respectively increased from 1,722 GWh/year (2023) to 2,859 GWh/year (2050) (for HTH), 718 GWh/year (2023) to 1,457 GWh/year (2050) (for LTH) and 71 GWh/year (2023) to 155 GWh/year (2050) (for cooling).

Detail analysis was carried out related to the distribution of the residential total energy delivered for space heating by different heating systems. And the distribution for the base year is as follows: electrical heaters with 28.56%, low-medium EE AC split system with 19.99%, LPG simple heaters with 19.23%, wood stoves with 17.52% and highly efficient AC split unit with 8.57%, low to medium efficient diesel boiler with 3.77% and highly efficient diesel boiler with 0.42%. Above mentioned analysis show that there is huge room for improvement efficiency on the supply side for guaranteeing space heating energy demand for the Albanian families. Also, it is important to be mentioned that there is not, for time being, any DH or CHP system suppling heat or hot water for residential, public, private building stock as well as industrial sector. Cooling in the household sector is all decentralised (mostly are individual split air-conditioning and very rare central AC system) and efficient AC split unit systems are contributing with 15-16%. Domestic hot water in the household sector is generated using almost decentralised systems based mostly on electrical boilers and solar hot water systems.

Distribution of the public building total energy delivered for space heating by different heating systems is as follows: low to medium efficient diesel boiler with 45.83%; highly efficient diesel boiler with 15.22%; low-medium EE AC split system with 18.33%; wood/pellet boilers with 6.82%, wood stoves with 2.24% and high efficient AC split unit with 3.06. Cooling of building space in the public building sub-sector is mostly in central buildings and very few in the public municipal buildings. Most of the AC systems are decentralised (mostly are individual split air-conditioning and very rare central AC system especially for very important central governmental buildings). Sanitary hot water in the public buildings sub-sector is generated using almost decentralised systems based mostly on electrical boilers (approx. 70-75%), central heating systems (approx. 10-15%) and solar hot water systems (approx. 10-15%).

Distribution of the private service and commercial buildings total energy delivered for space heating by different heating systems as follows: low-medium EE AC split system with 40.33%, highly efficient AC split unit with 26.40%, low to medium efficient diesel boiler with 5.24%; wood/pellet efficient boilers with 13.29% and highly efficient diesel boiler with 3.49%. Cooling of building space in the private building stock sector is approximately 82% decentralised (mostly are individual split air-conditioning and very rare central AC system) domestic hot water is generated using almost decentralised systems based mostly on electrical boilers and solar hot water systems.

The distribution of the total energy delivered for high temperature process heating energy and low temperature process heating by different heating systems is provided by: High-efficiency electrical furnaces with 28.82%, High-efficiency coal furnaces with 10.98%; Low-Medium coal furnaces with 20.40%, High-efficiency HFO furnaces with 6%, Low-Medium HFO furnaces with 7.63% High-efficiency HFO boilers with 6.65%, Low-Medium HFO boilers with 7.09%; and other with very small shares. Cooling of industrial enterprises is secure by following systems: electrical low to medium efficiency cooling chambers with 65%, high efficiency cooling chambers with 25%, low to medium cooling AC split unit with 6.5%, highly efficient cooling AC split unit with 3.5%.

Consultant team prepared heating, cooling and hot water maps covering the entire Albanian territory at the municipality level, which, while preserving commercially sensitive information, identified: i) heating and cooling demand for each municipality using consistent criteria for focusing on energy density parameter; ii) considering that actually does not existing any DH/CHP heating and cooling supply points; and iii) planned heating and cooling supply points identified new areas for the district heating and cooling will be analysed under Part III of this project.

Heating energy density for all sectors shows clearly that Kamza Municipality has the highest value equal to 2436 kWh/m^2*year (or 2436 MWh/km^2*year) much higher than the second value which belong to Tirana Municipality (equal to 546 kWh/m^2*year (or 546 MWh/km^2*year). Energy density for Kamza municipality is extremely high due to very small territorial area and very high-density buildings.

Scales of the Space Heating Energy Density are based on the maximum (excluding Kamza values), average and minimum values as it is presented at the following table.

Defined scales for preparing the MAP of the Space Heating Density

Nr	Nominated scale	Total Space Heating energy density for all sectors, kWh/m^2*year
1	MAX	1,701.27
2	AVERAGE	290.77
3	MIN	26.72
Defined scales for preparing the MAP of the Space Heating Density, kWh/m^2*year		
5	Very low	Lower than 50
6	Low	Between 51-120
7	Medium	Between 121-300
8	High	Between 301-550
9	Very high	Higher than 551

Source: Calculated by the Consultant

Cooling energy density for all sectors shows clearly that Kamza Municipality has the highest value equal to 883 kWh/m2*year much higher than the second value which belong to Tirana Municipality (equal to 253 kWh/m2*year. Scales of the Space Cooling Energy Density are based on the maximum (excluding Kamza's values), average and minimum values as it is presented at the following table.

Defined scales for preparing the MAP of the Space Cooling Density

Nr	Nominated scale	Total Space Cooling energy density for all sectors, kWh/m^2*year
1	MAX	253.16
2	AVERAGE	49.20
3	MIN	2.56
Defined scales for preparing the MAP of the Space Cooling Density, kWh/m^2*year		
5	Very low	Lower than 5
6	Low	Between 5.01-20
7	Medium	Between 20.01-50
8	High	Between 50.01-80
9	Very high	Higher than 80.01

Source: Calculated by the Consultant

Hot water energy density for all sectors shows clearly that Kamza Municipality has the highest value equal to 1,146 kWh/m2 much higher than the second value which belong to Tirana Municipality (equal to 537 kWh/m2). Scales of the Hot Water Energy Density are based on the maximum (excluding Kamza's values), average and minimum values as it is presented at the following table.

Defined scales for preparing the MAP of the Hot Water Density

Nr	Nominated scale	Total Hot Water energy density for all sectors, kWh/m^2*year
1	MAX	537.52
2	AVERAGE	85.30
3	MIN	7.21
Defined scales for preparing the MAP of the Hot Water Density		
5	Very low	Lower than 15
6	Low	Between 15.01-35
7	Medium	Between 35.01-80
8	High	Between 80.01-180
9	Very high	Higher than 180.01

Source: Calculated by the Consultant

Article 2a of the Energy Performance of Buildings Directive (EPBD 2010/31/EU, as amended by decision 2021/14/MC of the Ministerial Council of the Energy Community) requires that Albania establishes a Long-Term Building Renovation Plan to improve the energy efficiency of the national stock of public, private and residential buildings in a cost-effective manner. EE Directive and EE Law also promote improvement of the investment for reducing energy efficiency for the industrial enterprises. Part II of this report presents in details the actual situation related to two main aspects:

1. Detail analysis of the existing barriers for implementing EE/RES measures for reducing space heating, cooling and hot water energy consumption for four important sectors analysed in

Part I: residential, central & municipal public buildings, private services and commercial buildings as well as all industrial sub-sectors.

2. An overview of implemented and planned policies and measures for EE/RES measures for reducing space heating, cooling and hot water energy consumption.

The Albanian government has made strides in offering grants and incentives aimed at fostering energy efficiency in the residential buildings sector through MIE/AEE grating at the first and second phases Solar Hot Water Systems (SHWS) for 4,000 families (2000 families for each phase). These grants offer financial support for the acquisition of SHWS up to 90% of total purchased value. The results of the analysis presented in Part II suggests that significant opportunities exist in Albania to use energy more efficiently for meeting space heating, cooling and hot water energy demand. Efficiency in this context means providing an equivalent energy service at a lower total cost (i.e., at lower combined energy operating costs and EE implementation costs).

Part II summarizes some barriers to the implementation of EE/RES measures that are specific to the current situation in for meeting space heating, cooling and hot water energy services for residential, public buildings, private service buildings and industrial sector. Analysis is focused on those barriers that can be influenced by interventions at the microeconomic level. That is, the barriers in question can be removed - or at least reduced - by taking specific remedial actions for which nominated individuals can be held responsible. Macroeconomic barriers, such as the income level, whilst constituting a potential obstacle to improvements in energy efficiency, cannot be eased by one or two specific actions and therefore lie outside the scope of this analysis. Meanwhile, Part IV presents all steps needed to be undertaken for removing barriers, for introduction of EE/RES measures, all four economic sectors: residential, central and municipal public buildings, private service and commercial buildings as well as industrial enterprises.

Albania faced a number of challenges in implementing the measures contained in the NECP. Many of the measures required the cooperation of government ministries and other entities outside of the Ministry of Energy and Industry (MEI). However, cross-ministerial understanding, coordination and thus buy-in for the plan was lacking, preventing integration of the measures within broader sector plans. Furthermore, some measures were unrealistic in the timescales proposed and did not undergo a detailed impact assessment. The National Strategy of Energy (approved in August 2018) represents a synthesis of detailed energy sector analysis (including all sectors: residential, service sectors (including municipal and central public buildings), transport, industry, and other sectoral and cross-sectoral strategic and planning documents, much of which was incorporated into an analytical review of future development pathways for Albania's energy sector.

Albania's National Energy and Climate revised Plan addressed the five dimensions in an integrated way, for determining the national goals. The five dimensions of the Energy Union are: (i) energy security; (ii) the internal energy market; (iii) energy efficiency (iv) decarbonization; and (v) research, innovation and competitiveness. The NECP provides targets and following main measures/programmes for the 5 dimensions including EE/RES targets for the residential, service and industry sectors. Consultant has summarized all measures presented at the following and presented under NECP directly or indirectly related to EE/RES measures for improvements of EE/RES for improvement of heating, cooling, hot water energy demand for space heating, cooling, and hot water for all above mentioned sectors:

1) Implementation of minimum energy performance standards for existing and new buildings;
2) Energy renovation programme for occupied residential buildings;
3) Energy renovation programme for public (central and municipal) buildings;
4) Inspection of Building Technical Systems;
5) Energy efficiency obligation scheme and alternative measures for Albania;
6) Uptake of ESCO models;
7) Alignment of Municipalities Energy and Climate Action Plans with the BRP;
8) Municipal Heat Maps;
9) Policies to support RES in Heating and Cooling Sector;
10) Exemplary role of public sector.

Part III analyses the economic potential of different heating and cooling technologies according to the following in order: i) Calculate the average and maximum heating/cooling loads; ii) Calculate the peak load for the heat source (DHS); iii) Define the technical criteria necessary for heat network connection; iv) Determine the technical potential according to the baseline BAU scenario by proposing measures at the local level, as well as at the level of individual systems; v) Analyse costs and benefits for each proposed measure separately. Detail analysis is carried out for four sectors (households, public services, private services and industry) and determines the following types of loads for each of them: i) average heating load for heating; ii) peak (maximum) heating load for heating; iii) average cooling load for space cooling; and iv) peak (maximum) cooling load for space cooling. These loads, which have been calculated using the formulae proposed by the European Commission: i) in household and service sectors, the term heating includes space heating and DHW preparation, while the term cooling refers to space cooling only; ii) in the industrial sector, the term heating includes space heating and DHW preparation (lower temperature heating), as well as higher temperature heating preparation for industrial processes, while the term cooling includes space cooling and cooling for industrial processes. The total maximum heating load for heating in household, service and industrial sectors in Albania is 2768 MW, with the total maximum cooling load for cooling purposes in those sectors standing at 369 MW. Today, Albania has not any district heating and CHP systems and does not have any designed for high temperatures in distribution networks. This implies that new district heating and CHP systems to be planned as modern generation installations, access to new sources of renewable energy, efficient distribution infrastructure, highly efficient buildings renovated for low-temperature thermal energy supply, and as well as designed and planned with improved control of the heating system and heat metering with charging based on the actual consumption. European Parliament **on energy efficiency** (EED) includes the following definition: **efficient district heating and cooling** – a district heating or cooling system using at least 50% renewable energy, 50% waste heat, 75% cogenerated heat or 50% of a combination of such energy and heat. Total investment is estimated at around 385 million Euro and will be secured from State Budget, private investors with support from the European Regional Development Fund through the Operational Fund for Competitiveness and Cohesion.

Analysis shows for time being Albanian customers are using almost only one category of biomass: fuel wood. Analysis is carried out in detail for agricultural and livestock biomass as good potential to be used for meeting space heating demand through modern DH/CHP modern plants. All remaining manure from chicken (presented in detail above as the most concentrated stables in Albania) and other biomass from livestock and agriculture remains especially from greenhouses to deliver to biological biogas facility will be great energy source especially to be supplied to small to medium district heating plants close to 5 km to chicken farm stables.

Utilisation of solar hot water systems measure connects solar energy potential with the locations of the existing district heating systems by 2050. It is expected that more than 200,000-250,000 m2 of thermal collectors will be installed in the heating sector by 2050, with the total investment estimated approximately 105-110 million Euro. A greater integration of RES into district heating systems is estimated to result in a competitive price of heat in the market, which will in turn generate the need to construct new and expand existing distribution infrastructure. The harnessing of solar energy reduces the consumption of fossil fuels, which has a positive impact on the environment.

Utilisation of natural geothermal resources is estimated that the installed capacity in district heating systems will reach 10 MWt by 2050. A greater integration of RES into district heating systems is believed to result in the supply of heat at a highly competitive prices in the market, which will in turn generate the need to build new and expand existing distribution infrastructure. Apart from geothermal heat plants are also noteworthy, especially those of the base load type operating throughout the year with few short interruptions, especially close to curative centres. Such systems increase the efficiency of geothermal installations, and thus the cost-effectiveness of the entire geothermal project. Geothermal energy use reduces the consumption of fossil fuels, which has a positive impact on the environment.

Most renewable energy sources with low to moderate temperatures, such as solar, biomass, and industrial waste heat, geothermal, are difficult to convert efficiently into electricity using conventional power generation. Therefore, this encourages research on several thermodynamic cycles, such as the Rankine cycle, which was widely developed. The Rankine cycle, which involves isentropic compression in the pump, addition of pressure heat in the boiler, isentropic expansion in the expander, and release of pressure heat in the condenser, is suitable and can be used in steam power plants. After condensing steam, the working fluid is fed back into the evaporator to maintain a continuous cycle. Meanwhile, due to the Steam Rankine Cycle (SRC) limitations, the Organic Rankine Cycle (ORC) system has been developed as a solution to the use of low heat sources. At the present times the best CHP units using biomass and other RES sources are Organic Rankine Cycle types (ORC). The ORC process is based on utilization of organic substance mediums, which have favourable thermodynamic properties at lower temperatures and pressures. These include hydrocarbons such as iso-pentane, iso-octane, toluene, and silicon oil. The heat produced in the furnace enters the ORC process, through the flue gases which transmit the heat to the thermal oil exchanger. This technology has many technical advantages, such as; high cycle efficiency, very high turbine efficiency (up to 90%), low mechanical stress etc. In addition, it has many operational advantages such as; simple start-stop procedures, automatic and continuous operation, quiet operation, etc. The two main equipment of a CHP plant with ORC technology are the Thermal Oil Boiler, and the Modular CHP plant. The Modular CHP plant includes ORC turbo generator, condenser, regenerator, and evaporator. Below there is the conceptual configuration of a CHP boiler-filter-generator unit.

Consultant team completed a cost-benefit analysis: for its territory based on climate conditions, economic feasibility and technical suitability, in accordance with **Annex XI of the EED Recast, the EECG evaluated cost-optimal solutions for heating and cooling different options for different sectors, ensuring they are both economically viable and energy efficient.** EECG team carried out **cost benefit analysis** of different technologies for heating and cooling covering, for all four main sectors of Albania based on the requirements of the Article 25(3) **and identified important scenarios: i) baseline scenario based on the Strategy of Energy of Albania for the above mentioned sectors; and ii) efficient and RES heating and cooling supply scenario with much higher penetration compared with NECP-WAM (With Additional Measures) by introducing more efficient and renewable heating and cooling technologies, distinguishing between energy derived from fossil and renewable sources where applicable.** EECG team calculated in details all following technologies for **four sectors** based on cost benefit analysis:

- All **measures involving the replacement of central firewood boilers** with central modern biomass boilers for space heating and DHW preparation also proved be cost-effective (FNPV > 0 and ENPV > 0). Moreover, modern biomass has a somewhat higher CO_2 emissions factor than firewood.
- The measure involving central firewood boiler replacement with heat pumps also proved to be cost-effective (FNPV > 0 and ENPV > 0).
- Under the proposed measures in the household sector, **a complete cessation of fuel oil use** as a drive energy product for space heating and DHW preparation is foreseen by 2030. The measures propose the replacement of existing fuel oil-fired sources of heat with modern biomass boilers and heat pumps, and installation of solar collectors notably for the purpose of DHW preparation. All proposed measures of replacing fuel oil-fired sources of thermal energy for space heating and DHW preparation are cost- effective without support (FNPV > 0 and ENPV > 0). The result is expected given that fuel oil is an environmentally unacceptable energy product with a high CO_2 emissions factor compared to modern biomass or electricity. Furthermore, the price per unit of fuel oil is considerably higher than modern biomass price. Where heat pumps are used, the decisive element is, naturally, the fact that heat pump efficiency (SPF) is considerably higher than that of fuel oil-fired thermal energy sources. The **replacement of direct electric resistance space heating** with compression heat pumps in the household sector is definitely cost-effective (FNPV > 0 and ENPV > 0) in view of a considerably higher efficiency (SPF) of heat pumps compared to electric resistance space heating and cooling as well.
- And finally, where DHW preparation is concerned, it is important to prepare domestic hot water efficiently using solar collectors, heat pumps, biomass boilers integrate with solar panels and the latest one to be A+ electric boilers. heat pumps, renewable energy sources, such as solar thermal and biomass, other than those used for high efficiency cogeneration (geothermal has very low potential in Albania – however also it was considered in the analysis) and EE cogeneration.
- Introducing small to medium district heating capacity systems for hospital and dormitory centres (reducing heat and cold losses from existing district networks – in Albania very few hospitals centre have district heating); Introducing new scheme for district heating and cooling and checking the possibility for tree-cogeneration (heating-cooling-electricity).
- Whenever technically feasible, fossil fuel stoves and boilers are to be replaced with renewable energy sources and more efficient technologies such efficient wood/pellet boilers for rural areas as well as heat pumps (AC EE split systems). Based on the cost-benefit analysis, the **measure of replacing individual firewood stoves** with very efficient stoves and central firewood boilers up to 2030 proved to be cost-effective (FNPV > 0 and ENPV > 0).
- An increase in emissions prices has the effect of actually increasing the monetised benefits of reducing CO_2 emissions. For households, the use of measures involving natural gas micro-CHP and the installation of solar collectors for DHW preparation becomes economically

justified when higher emissions price is applied. For services, such measures are those involving the replacement of diesel (or fuel oil) boilers with modern biomass boilers and solar heating combined with a condensing boiler or with water-to-water compression heat pumps.

Part IV is analysing in very details "Potential New Strategies and Policy Measures" and first part of this chapter is presenting the summary of the barriers of implementing EE/RES measures together with the respective remedies and responsible institutions for all four sectors. Analysis presents the most suitable respective financial models for EE/RES improvements in residential, public buildings, private service buildings and industrial enterprises related directly with the Albanian conditions. Also, consultant team presented under Part IV the respective all policies and measures which shall be executed to ensure the roadmap's decarbonisation targets to be achieved for all four sectors.

Overview of policies and measures for the decarbonization of Albania's Heating and Cooling for building stock and industry sectors

No.	Policies and measures title	Type	Estimated Investment needs [EUR]
1	Implementation of minimum energy performance standards for existing and new buildings	Legislative	325,000 (until 2030)
2	Energy renovation programme for occupied residential buildings	Legislative / Financing / Investment	Soft part 450,000 (until 2030) 17.86 billion* (until 2050)
3	Energy renovation programme for public (central and municipal) buildings	Legislative / Financing / Investment	Soft part 1.61 billion* (until 2050)
4	Energy renovation programme for private service and commercial buildings	Regulatory; Financial; Information	Soft part 5.75 billion* (until 2050)
5	Eradicate energy poverty	Legislative	50,000 (until 2030)
6	Development of financial support schemes for improving energy efficiency / utilizing renewable energy in buildings	Legislative; Financial	500,000 (until 2030)
7	Inspection of Building Technical Systems	Legislative; Technical	200,000 (until 2030)
8	Energy efficiency obligation scheme and alternative measures for Albania	Legislative	20,000 (until 2030)
9	Uptake of ESCO models	Legislative	100,000 (until 2030)
10	Alignment of Municipalities Energy and Climate Action Plans with the BRP	Legislative	30,000-80,000 per municipality (until 2030)
11	Energy spatial planning for increasing the share of renewable energy and improve energy efficiency	Legislative	500,000 (until 2030)
12	Mechanism of net metering for installations up to 500 kW	Legislative	30,000 (until 2030)
13	Supporting the formation of renewable energy communities	Legislative	170,000 (until 2030)
14	Municipal Heat Maps	Legislative	500,000 (until 2030)
15	Policies to support RES in Heating and Cooling Sector including CHP systems	Legislative	50,000 (until 2030)
16	Creation of one-stop shops for the energy performance of buildings	Awareness	1,000,000 (until 2030)
17	Deployment of solar energy installations on buildings	Legislative	50,000 (until 2030)
18	Promotion of district heating, CHP schemes (and triple generation: heating, cooling and power) and neighbourhood approaches and integrated renovation programmes at district level, addressing issues such as energy, mobility, green infrastructure, waste and water treatment and other aspects of urban planning	Legislative / Awareness	100,000 (until 2030)
19	Exemplary role of public sector	Legislative	50,000 (until 2030)
20	Addressing skills gaps and promoting education, targeted training, upskilling and reskilling in the construction sector and energy efficiency and renewable energy sectors	Awareness	300,000 (2026-2027)
21	Awareness-raising campaign	Awareness	300,000 (until 2030)

* *Note: the investment needs do not mean the allocation of sources of funding from the state budget. The renovation implementation programme(s) for the different periods (for example 2026 - 2030), should allocate the sources of financing for different residential building types. Source: LTBRAP*

Among other details, under Part IV is presented for each measure the descriptions contain budget estimates that are intended to provide orientation for the detailed planning of the individual PaMs.

The up-front transaction costs/enabling environment soft investments, are also determined, i.e., implementation programmes, technical studies, promotional activities, technical assistance, trainings, development of guidelines/instructions, etc., which are necessary to make an investment successful in terms of achieving the objectives of a policy and measure. It shall be clear that the actual sums depend on the level of detail and the experts involved (national/international), and also on existing resources that could be utilized. The description of policies and measures also contains a section on the implementing entity.

Residential building sector final energy targets to achieve a fully decarbonized building stock by 2050: In the base year 2023, the final energy demand of the residential building stock was 504.14 ktoe based on the Energy Balance of 2023. By 2050, the final energy demand is expected to decrease to 447.84 ktoe, representing a decrease of about 11.2% compared to 2023. In comparison, the final energy demand of the NECP scenario is equal to 483,4 ktoe in 2050. In the base year 2023, the GHG emissions of the residential building stock were calculated to be 337.5 kt CO_2eq. By 2050, the emissions are expected to decrease to 57.3 kt CO_2eq, representing a decrease of about 83.02% compared to 2023. In comparison, the GHG emissions of the NECP scenario is equal to 123.40 kt CO_2eq in 2050. In regard to worst performing buildings (WPB), it is envisaged to prioritizing the renovation of worst-performing buildings resulting in a gradual phasing out by 2039.

Public building sector final energy targets to achieve a fully decarbonized building stock by 2050: In the base year 2023, the final energy demand of the public building stock was calculated to be 43.95 ktoe based on the Energy Balance of 2023. By 2050, the final energy demand is expected to increase to 65.22 ktoe, representing an increase of about 48.4% compared to 2023. In comparison, the final energy demand of the NECP scenario is equal to 68.01 ktoe in 2050. In the base year 2023, the GHG emissions of the public building stock were calculated to be 42.97 kt CO_2eq. By 2050, the emissions are expected to increase with at a moderate rate to 54.88 kt CO_2eq, representing an increase of about 27.63% compared to 2023. The increase in emissions compared to 2023 is primarily due to the very low comfort level of public buildings in the base year. The scenario predicts the fulfilment of comfort conditions in 2050 and at the same time the fulfilment of CO_2 reduction targets compared to the WEM scenario. At the same time in comparison, the GHG emissions of the NECP scenario is equal to 59.96 kt CO_2eq in 2050 (which are higher than decarbonisation scenario presented above equal to 54.88 kt CO_2eq).

Commercial and private sector buildings final energy targets to achieve a fully decarbonized building stock by 2050: In the base year 2023, the final energy demand of the commercial and private sector building stock was calculated to be 180.78 ktoe based on the Energy Balance of 2023. By 2050, the final energy demand is expected to increase to 271.22 ktoe, representing a decrease of about 50.0% compared to 2023. In comparison, the final energy demand of the NECP scenario is equal to 282.87 ktoe in 2050. In the base year 2023, the GHG emissions of the commercial and private sector building stock were calculated to be 176.73 kt CO_2eq. By 2050, the emissions are expected to increase to 239.75 kt CO_2eq, representing an increase of about 35.67% compared to 2023. The increase in emissions compared to 2023 is primarily due to the low to medium comfort level of private buildings in the base year. The scenario predicts the fulfilment of comfort conditions in 2050 and at the same time the fulfilment of CO_2 reduction targets compared to the WEM scenario. At the same time in comparison, the GHG emissions of the NECP scenario is equal to 277.65 kt CO_2eq in 2050 (higher than decarbonisation scenario presented above equal to 239.75 kt CO_2eq).

Industry sector final energy targets to achieve a large scale decarbonized related to industrial process heating (higher heat energy demand), space heating (lower heat energy demand), industrial process cooling and space cooling energy demand by 2050: In the base year 2023, the final energy demand of the industrial sector was 405.52 ktoe based on the Energy Balance of 2023. By 2050, the final energy demand is expected to decrease to 279.84 ktoe, representing a decrease of about 31% compared to 2023. In comparison, the final energy demand of the NECP scenario is equal to 303.32 ktoe in 2050. In the base year 2023, the GHG emissions of the industrial sector were calculated to be 317 kt CO_2eq. By 2050, the emissions are expected to decrease to 253 kt CO_2eq, representing an decrease of about 20% compared to 2023. In comparison, the GHG emissions of the NECP scenario is equal to 299 kt CO_2eq in 2050.

Forecasted installed heating/cooling capacity of DH/CHP, for the period 2023-2050, for all four residential, public, private service and commercial buildings as well as industry sectors. Analysis shows clearly that installed capacity of DH/CHP will reach 518 MW and the highest share belong to industry and commercial (new tourism resorts). Analysis shows clearly that RES contributions have the potential to be increase their contribution from 57.4% (2023) up to 74.98% (2050) and all RES measures selected are cost optimal and financially feasible. Forecasted RES contribution (GWh) for meeting heating/cooling/DHW for the central and municipal public buildings sector and analysis shows clearly that RES contributions have the potential to be increase from 50% (2023) up to 65% (2050) and all RES measures selected are cost optimal and financially feasible. Forecasted RES contribution (GWh) for meeting heating/cooling/DHW for the private service and commercial building sector and analysis shows clearly that RES contributions have the potential to be increase their contribution from 49% (2023) up to 61% (2050) and all RES measures selected are cost optimal and financially feasible. Forecasted RES contribution (GWh) for meeting heating/cooling/DHW for the industry sector and analysis shows that RES contributions have the potential to be increase from 17% (2023) up to 33% (2050) and all RES measures selected are cost optimal and financially feasible. Forecasted RES contribution (GWh) for meeting heating/cooling/DHW for the all four above mentioned sectors and analysis shows that RES contribution will be increased from 45% (2023) up to 70% (2050) for meeting space heating, cooling and hot water energy demand.

Realizing the full energy saving potential based on cost effective measures would require a total cumulative investment of around 28,227 million EUR until 2050, which would generate annual cost savings to owners and end-users of about 4,325 million EUR, meaning that the savings would cover the cost of the measures within about 6.53 years for decarbonization of the overall heating/cooling/hot water energy demand for the residential, public, private and industry sectors. This conclusion would justify the implementation of all EE/RES measures proposed in this important project. Despite increased use of local energy resources, such as solar energy and biomass, Albania depends on 10-25% imports of electricity, and 100% import from oil by products which overall accounted for about 35% of its energy primary energy supply in 2023. The introduction of EE/RES measures can enhance energy security by: (a) reducing imports of oil by-products and thereby reducing the trade deficit; (b) cutting down on the consumption of fire wood and thereby preventing deforestation; and (c) minimizing the volume of electricity imports, (d) increasing the RES utilization, (e) reaching full decarbonization of building stock, (f) and reaching NECP respective targets and thereby reducing the need for government subsidies. Energy savings for meeting heating/cooling/hot water energy demand for the residential, public, private and industry sectors show will bring reduction of the total primary energy consumption with 16-20% and thus the reduction of energy imports with 28-30%.

Improvement of the fiscal balance is a high priority for the GoA and EE/RES measures represent an opportunity for the government and the public sector to reduce their energy budget expenditures and, as analysis shows, the public sector can save large budgets by introducing EE/RES measures in buildings. EE/RES investments have a positive economic impact since they contribute to the development of a modern industry that offers jobs and a range of business development opportunities. They also generate revenues from increased taxation on the construction work required for EE implementation, which creates a positive situation, whereby the GoA's need to optimize tax revenues is supported by the development of an EE market with its various associated social and environmental benefits. This presents an opportunity for the GoA to ensure that such renovations are realized in an energy-efficient way that contributes to the Albania's sustainable economic development.

Looking at the full range of job opportunities, there is a wide range of skills required. In manufacturing, construction and retrofit, distribution and other areas, alongside highly skilled and technical jobs, there are also many positions available for a less skilled workforce, which currently suffers most from high unemployment rates. For the most part, the labor market is good added value to the economy. Analysis of many EE programmes in EU countries shows, the installation of energy efficient elements and technologies tends to be more labor intensive than manufacturing them, so that when policy is looking for areas of growth, the energy efficiency of buildings should be one of the top priorities. Job development in energy efficiency of buildings is a key field where economic growth brings with it reductions in carbon emissions and increased energy security. Therefore, taking into account these numbers, it can be estimated that EE and renewable energy renovations across different building sectors and industry sectors will generate significant employment opportunities in Albania, i.e., approximately a total of 35,000-40,000 jobs across the entire building stock and industry sectors.

Part I - OVERVIEW OF HEATING AND COOLING ENERGY CONSUMPTION AND ENERGY DEMAND FORECASTING

I.1 Main Data Used and Relevant Project Context

I.1.1 Main data used for heating and cooling study

During the inception stage, collection and analysis of all available data was carried out. Consultant team reviewed all available documents based on the National Energy Strategy (2018), National Energy and Climate Plan (NECP) and using all official data based on the Yearly Energy Balances, Energy Strategy and National Energy and Climate Action Plan, which contributed to the understanding of the subproject and technical factors. The assessment hereafter starts with the main studies made available and considered during the Inception Stage. Documents analysed by the consultant team are:

- Yearly Energy Balance for the whole period 2010-2023 according to AKBN/INSTAT;
- Long-Term Building Renovation Plan approved on February 2025;
- INSTAT CENCUS 2023 - population and building registration;
- Official ERE Annual reports related to Power Sector Electricity Balance prepared from ERE for years 2018, 2019, 2020, 2021, 2022 and 2023;
- GDP sectorial development 2018-2023 – (National Bank of Albania and the World Bank);
- Albania's commitment to the Paris Accords for Climate Change, ratified by law no.75/2016, dated 14.07.2016, "On the ratification of the Paris Accord, within the United Nations Framework Convention on Climate Change," Official Journal No. 146/2016;
- Different Energy and Climate Obligations under the Energy Community;
- National Strategy for Development and Integration – 2025-2030;
- Albanian Renewable Energy Source Action Plan (NREAP adopted by the Governmental Decree no.27, dated 20.01.2016);
- 1st National Energy Efficiency Action Plan 2011-2018 (Government Decree no. 619, date 7.09.2011);
- 2nd and 3rd Albanian Energy Efficiency Action Plan 2017-2020 (Government Decree no.709, date 1.12.2017);
- National Determined Contribution (NDC approved by the Albanian Government on September 2015);
- The Decision of the Council of Ministers (DCM) no. 519, dated 13.07.2016 "On the approval of the Market Model of the Power Sector";
- The DCM no. 125, dated 11.02.2015 "On the approval of the financial recovery plan in the power electricity sector";
- Albanian National Gas Master Plan (November 2016);
- Law on Power Sector No. 43/2015, dated 30.04.2015;
- Law on Renewable Energy Sources No. 7/February 2017 and revised on 2021;
- Law on Hydrocarbons No. 6/February 2017;
- Law on Natural Gas No.102/2015, dated 23.09.2015;
- Law on Energy Efficiency No. 124/2015, dated 12.11.2015 and draft version ready to be approved by the end 2025;
- Law on Energy Performance in Buildings No. 116/2016, dated 10.11.2016; amended on June 2025;
- Law on Climate Change (2018);
- General National Territorial Plan (DCM No. 881, dated 14.12.2016) based on the Law on Territorial Planning (No. 107/2014, dated 31.07.2014);
- 1st, 2nd, 3rd, 4rth National Communication of Albania to the UNFCCC (FNC – 2002, 2009, 20216, 2023);
- Many other reports prepared from the Donor Community (USAID, Energy Secretariat, UNDP, WB, IFC, EU, EBRD, KfW, UNIDO, GIZ, SECO, ADA) related to development of the Albanian energy sector in general and power sector in particular have checked for specific data and reviewed for their analysis;
- Different Energy Audits prepared by the consultant team in residential, public buildings, private buildings and industry sector.

This report presents the space heating, space cooling and water heating energy demand for Albania taking into consideration all above mentioned documents, and is fulfilling three main targets:

- Maximising progress to Albania's 2030 target of an improvement in energy efficiency of 9.6%;
- Increasing RES for Albania economic sectors in general and power sector in particular to meet 54.4% of total final energy demand forecast according to baseline scenario;
- Reaching the CO2 target of 21% reduction for all economic sectors.

The methodology used for space cooling and water heating energy demand is based on the bottom-up approach at the national level for all energy sectors. The main assumptions that are used for these space cooling and water heating energy demand scenarios are:

- The energy demand forecast is made based on a set of key documents, such as the Albania Energy Strategy, NECP, Albania Renewable Sources' Implementation Plan, Energy Balances 2011-2023, Electro-Energy Demand Forecasts by OST, and different studies currently being undertaken by different IFIs, supported by international assistance for development of new generation capacities in thermal and renewable energy sources;
- Historic data related to primary and secondary energy sources for the period 2010-2023. This group included all energy sources: space cooling and water heating energy demand, electricity generation, transmission and distribution figures, oil and its derivatives, coal/lignite, firewood, solar and hydro energy;
- Historic data related to secondary energy source consumption. This group covered consumption of all energy commodities in general and electricity in space cooling and water heating energy services.

GDP actual and future development for different sectors together number of population, number of dwellings, areas of residential buildings, number and areas of municipal & central public service buildings, number and areas of private service and commercial buildings are the main driving factors for forecasting space cooling and water heating energy services.

I.1.2 Economic Development

The main factors for calculating electricity energy demand for the industrial sub-sectors is the GDP increase, share of different fuels, intensity of each energy service based on the data used in the Strategy of Energy for the Industry. Based on the reports of the Bank of Albania, the World Bank and EBRD, the progress of the economic development of Albania is expressed by the GDP shown in the table I-1 and figures I-1 - I-4.

Table I-1: Development of real and nominal GDP (Billion Euro) (2015 – 2023)

Parameter	Annual Real and Nominal Value of GDP, in Billion Euro								
	2015	2016	2017	2018	2019	2020	2021	2022	2023
GDP in real terms	11.387	11.764	12.212	12.703	12.968	12.539	13.657	14.320	14.812
GDP in nominal terms	11.387	11.862	13.020	15.156	15.402	15.163	17.931	18.916	22.978

Source: Prepared by the Consultant based on reports of Bank of Albania, World Bank, and EBRD (2015-2023)

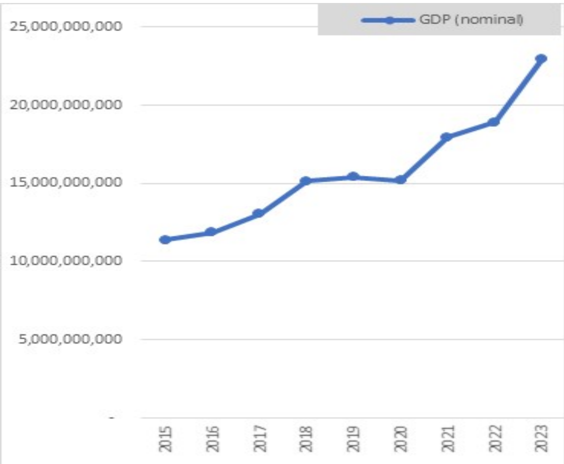


Figure I-1: Progress of GDP in nominal terms, for the years 2015-2023, Euro

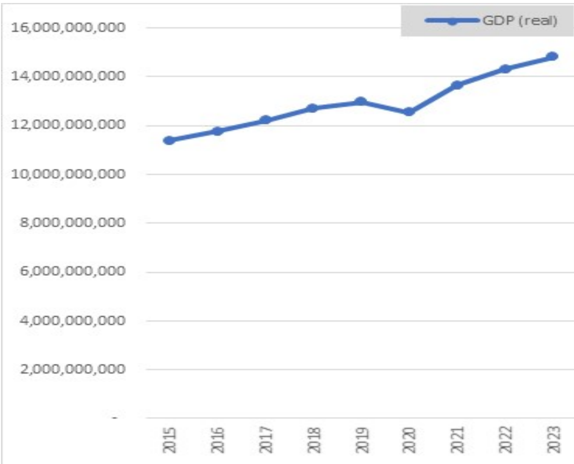


Figure I-2: Progress of GDP in real terms, for the years 2015-2023, Euro

Source: Prepared by the Consultant based on the Strategy of Energy and NECP

Source: Prepared by the Consultant based on the Strategy of Energy and NECP

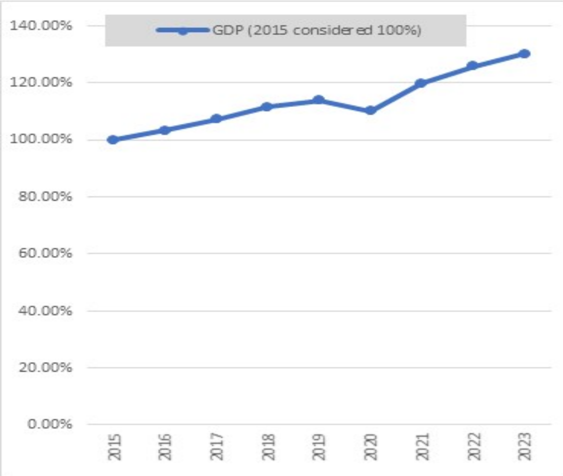


Figure I-3: Growth of GDP in real terms, for the years 2015-2023, in %

Source: Prepared by the Consultant based on the Strategy of Energy and NECP

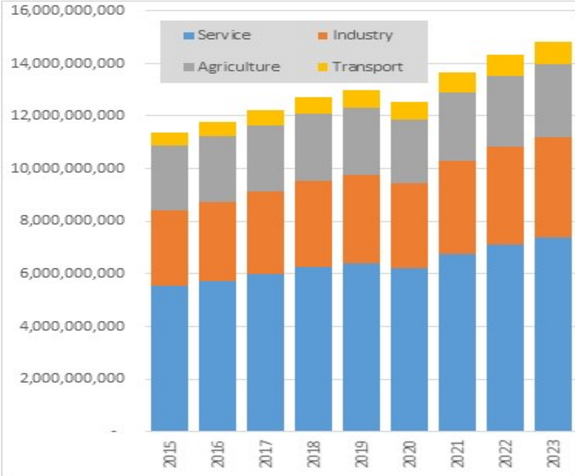


Figure I-4: Progress of GDP in nominal terms and the contributions of each sector, Euro

Source: Prepared by the Consultant based on the Strategy of Energy and NECP

The analysis shows a 30% increase of the GDP in real terms. The breakdown in sectors is the following: service sector 49.84%, industry 27.75%, agriculture 18.60% and transport 5.80%. GDP trends for the future and used under the NECP will be used as main driving factor for calculating electricity demand for industry and agriculture sectors.

Albania consume less primary energy than Western Balkan countries, which is 0.8 toe, but this is mainly due to the fact that the total electricity production in Albania comes from hydropower plants, unlike WB where 60% of the electricity is produced by lignite power plants, which requires three times more primary energy compared to the hydro power plants.

On the other hand, by comparing how much energy is needed to produce 1 EUR, it turns out that Albania is at the average level of the WB countries in the. Albanian energy efficiency is about 60% less efficient than the EU28 average. Only Serbia, North Macedonia, Kosovo, BiH and Bulgaria are less efficient than Albania. Proposed measures, especially in the area of energy efficiency, will increase the productivity without high growth rate the increasing energy consumption, bringing Albania closer to the EU 28 average. Macro-economic data, such as Gross Domestic Production by all economic sectors of Albania: industry, private services and agriculture and other sectors are the basis for forecasting the electricity energy demand for each sector. Annual GDP forecasts for the period 2025-2050 (and for the period 2051-2060 are extrapolated by the consultant team) are based on Albania Energy Strategy and the yearly respective values are presented in Table I-2.

Table I-2: GDP growth rate (%) forecast for Albania[4] (Euro)

Country	2021	2023	2024	2025	2026	2027	2028	2029	2030	2035	2040	2045	2050
Albania	3.0	3.4	3.6	3.8	4.0	3.9	3.9	3.8	3.8	3.5	3.5	3.0	3.0

Source: Prepared by the Consultant based on the Strategy of Energy and NECP (2021-2050)

I.1.3 Primary Energy Supply

Figures I-5 and I-6 present the trends of the primary energy supply by the different energy resources for the year 2023. The analysis of the graphs shows that the overall share of oil by-products amounts 52.40%, hydropower and net imports of electricity 31.70%, fuelwood 6.34%, coal is 5.93 %, natural gas produced in the country 1.77%, and solar energy 1.60%.

[4] Energy Strategy until 2030, National Climate and Energy Action Plan until 2050, consultant assumption until 2060.

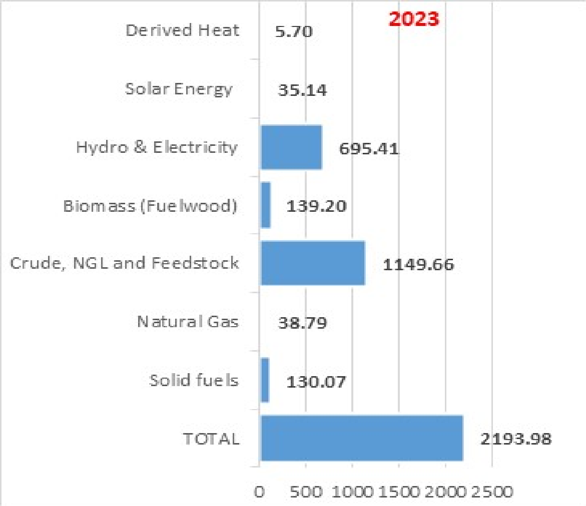


Figure I-5: Supply of energy resources for the year 2023 (in ktoe)
Source: Prepared by the Consultant based on Albanian Energy Balance 2023, INSTAT, MIE/AKBN

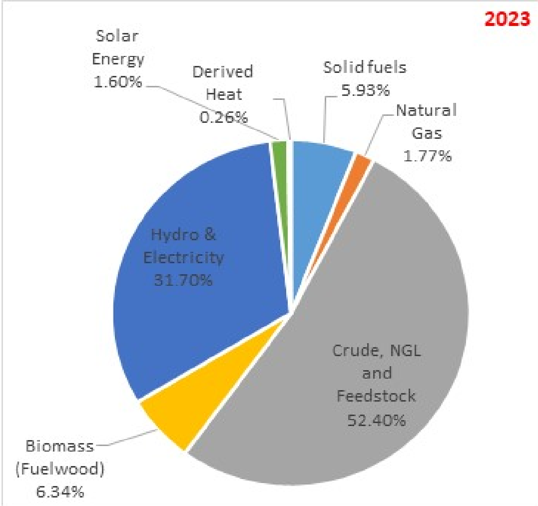


Figure I-6: Supply of energy resources for the year 2023 (in %)
Source: Prepared by the Consultant based on Albanian Energy Balance 2023, INSTAT, MIE/AKBN

I.1.4 Final Energy Consumption

Figure I-7 presents the trend of the supply of energy resources for the years 2015-2023. The analysis of the graphs shows that the contribution of oil by-products holds the main weight, followed by hydroelectric energy, fuelwood, coal, natural gas and solar energy (which continues to grow year after year). The analysis clearly shows an increase of electricity generation from hydro as well as, during last few years, from Solar PV Independent Power Producers (IPPs), reaching the main objective of the country to be self-sufficient towards electricity generation by 2030. The reduction of oil by-products supports the reduction of GHG emissions and at the same time substitutes oil by-products, which are expensive and imported energy commodities, with RES, which are relatively cheaper and national energy sources.

Figure I-8 illustrates the trends in final energy consumption across all sectors from 2015 to 2023. The graphs indicate that the average annual final energy consumption is approximately 2,000 ktoe, with a slight reduction observed from 2021 to 2023. The analysis also highlights a significant decrease in 2020, primarily due to the COVID-19 pandemic. Additionally, oil by-products constitute the largest share of final energy consumption.

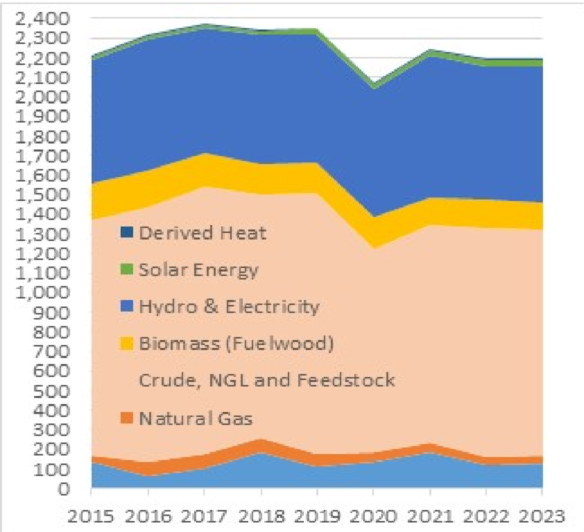


Figure I-7: Trends of the supply of energy resources for the period 2015-2023 (ktoe)
Source: Prepared by the Consultants based on Albanian Energy Balance 2023, INSTAT, MIE/AKBN

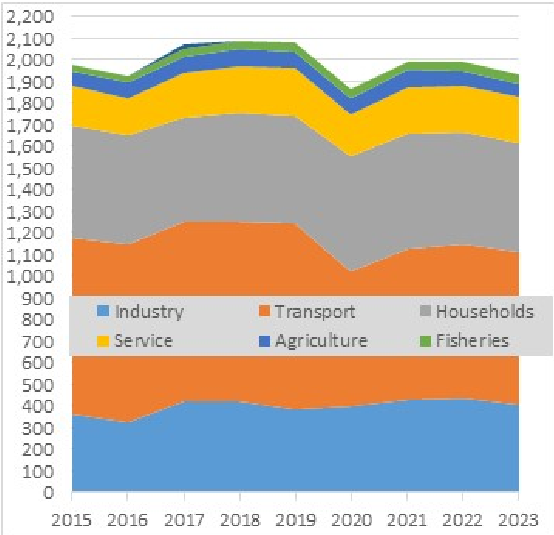


Figure I-8: Trend of the final energy consumption for all economic sectors, 2015-2023 (ktoe)
Source: Prepared by the Consultant based on Albanian Energy Balance 2015-2023, INSTAT, and MIE/AKBN

I.2 Heating, Cooling and Hot Water Energy Demand

This chapter "Heating, Cooling and Hot Water Energy Demand" is including the baseline scenario by identifying heating, cooling and water heating for four sectors: 1. Residential reference buildings, 2. Central and Municipal Public reference buildings, 3. Private Service and Commercial reference buildings, and 4. Industrial sectors. Baseline scenario is prepared based on the Strategy of Energy of Albania, NECP, LTBRAP for the above-mentioned sectors taking into consideration few EE measures for each energy service.

Energy consumption for agriculture sector is presented at the figure I-8.1 and analysis shows that consumtion has been reduced 79.00 ktoe (2010) to 63.02 ktoe (2023). Same figure shows the agriculture energy consumption expressed in % versus total final energy consumption for the whole period. And the result shows that Agriculture sector has consummed from 4.21%-3.26% versus total final energy consumption for the same year. Also, it is important to be mentioned that almost 85-90% of energy is consummed agro-machinery (as m echanical energy) and only 10-15% is consumed for irrigation, heating of stables and cooling chambers.

Energy consumption for fisheries sector is presented at the figure I-8.2 and analysis shows that consumtion has been increased 20.00 ktoe (2010) to 63.02 ktoe (2023). And fisheries sector has consummed from 1.06%-2.08% versus total final energy consumption for the same year. Also, it is important to be mentioned that almost 90-92% of energy is consummed as mechanical energy and only 8-10% is consumed for cooling chambers inside fish fleet and in the fish ports.

So, being lower than 5% agriculture and fisheries sectors will not be further considered under this analysis.

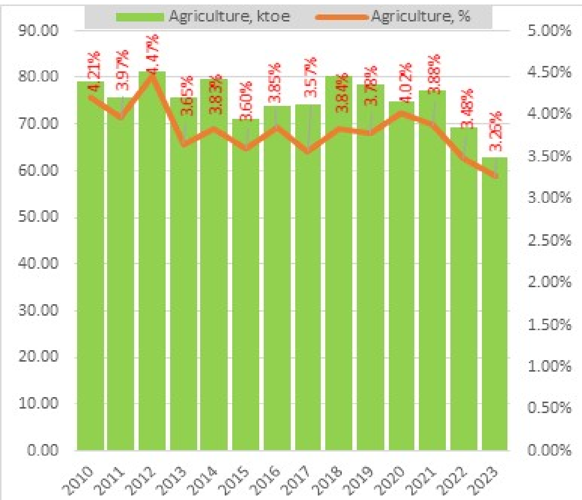


Figure I-8.1: Trend of final energy consumption for agriculture sector for the years 2015-2023 (ktoe and % vs total Final En. Cons.-FEC)

Source: Calculations performed by EECG consultants based on the Albanian Energy Balance 2015-2023, INSTAT, MIE/AKBN

Figure I-8.2: Trend of final energy consumption for fishery sectors for '15-2023 (ktoe and % vs total FEC)

Source: Calculations performed by EECG consultants based on the Albanian Energy Balance 2015-2023, INSTAT, MIE/AKBN

I.2.1 Residential Sector

Energy consumption and forecasted demand for the residential sector was carefully analysed and calculated because of its highest contribution in the total energy consumed, as well as because of the very high electricity and other different energy commodities consumption for meeting space heating, cooling and water heating energy demand services. Figures I-9 - I-10 present the trends of the final energy consumption. Analysis shows a slight decrease of the energy consumption in the residential sector for the period 2021-'23. This decrease is related to several factors: increased energy efficiency due to rising energy commodity prices, improved quality of new residential buildings, and a reduction in population due to emigration. The analysis shows that electricity accounted for about 56% of residential energy consumption in 2023, followed by fuel wood at around 22%, mainly used in rural and suburban areas. LPG and diesel make up roughly 19%. Solar energy for hot water and PV Autoproducers have entered the residential sector recently.

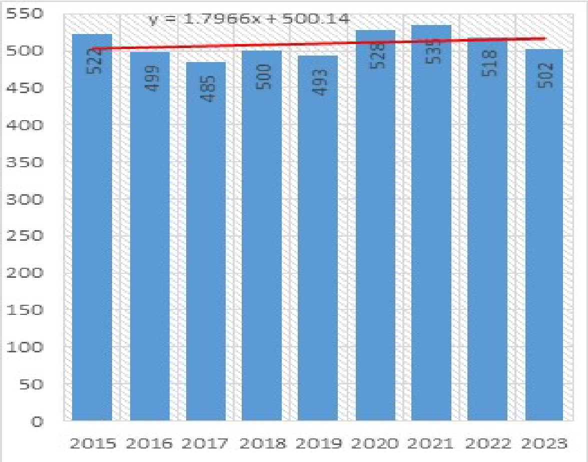


Figure I-9: Final energy consumption for the Residential Sector for the years 2015-2023 (ktoe)
Source: Prepared by the Consultant based on the Albanian Energy Balance 2015-2023, INSTAT, MIE/AKBN

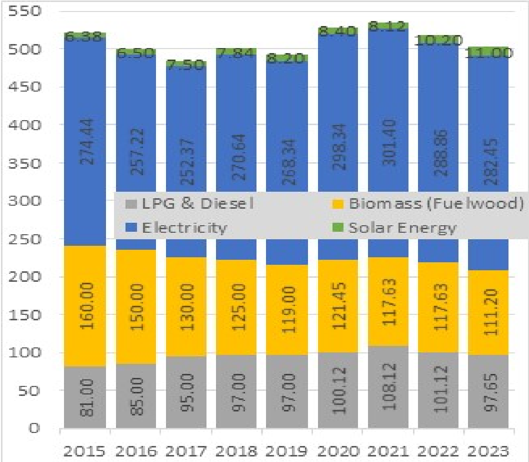


Figure I-10: Final energy consumption for the Residential Sector for the years 2015-2023 (ktoe)
Source: Prepared by the Consultant based on the Albanian Energy Balance 2015-2023, INSTAT

The final energy commodities demand was forecasted to covering of space heating, space cooling, water heating, cooking, lighting and electrical equipment by carrying out calculation based on the following five steps below:

Step 1: Residential Buildings Forecast was carried out based CENSUS-2023, Long Term Building Renovation Action Plan (approved on February 2025) and on the trend development of inhabitant/dwelling. Number of dwellings/dwellings was used as the driving factor for calculation of final energy demand at municipality level for each climatic zone of Albania. Final energy consumption in the residential sector is depended on several factors:

- Number of populations, number of residential dwellings;
- Number of the persons per dwelling;
- Distribution of dwelling per each climatic zone 1, 2, 3;
- Type of residential buildings: Detached house, Semi-detached house, Row (or terraced) house and Multi Apartment Buildings (MABs);
- Average area of occupied per residential buildings for each of the above-mentioned category.

The following sections is providing the analysis of these parameters and their breakdown in three climatic zones: 1, 2, and 3. The calculations have been made based on the concept of Heating Degree Days (HDD), Single Houses (breakdown in four type of sub-categories of SHs) and Multi Apartment Buildings (MABs) and six energy services (purposes) covering the basic energy needs of residential families: space heating, space cooling, water heating, lighting, cooking and electric equipment. Figure I-11 presents a schematic presentation of all factors that participate in energy consumption for the current situation and in the future for the residential sector.

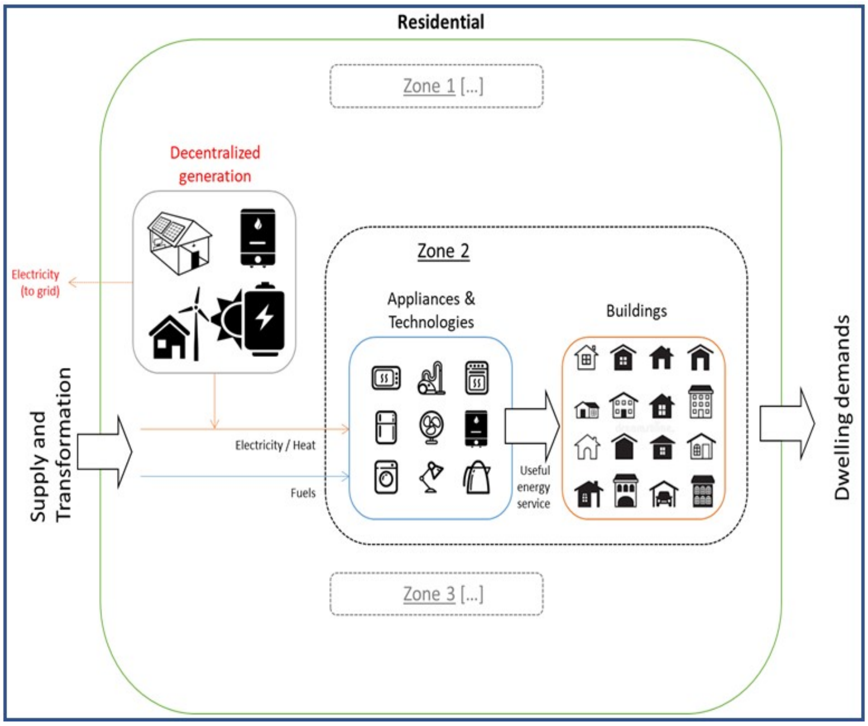


Figure I-11: Factors in energy consumption for the residential sector
Source: Prepared by the Consultant

An important factor, with direct impact in the energy consumption in the residential sector, is the number of the population. The resident population in Albania, according to the Census from September 2023, amounts 2,402,113. Referring to the 2011 Population and Housing Census, the resident population in Albania was 2,821,977. For the period 2011-2023 a net decrease of approximately 420,000 (14.28%) is evident. This decline fits with the trend observed over the last three decades, as of the 1989 Census and figure I-12 presents a summary of population trend in Albania based on the Census assessments for the whole period 1973 – 2023.

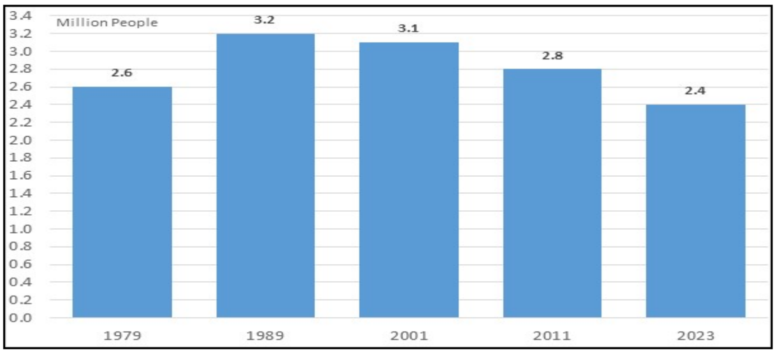


Figure I-12: Population by Census for the respective years (in million)
Source: INSTAT estimations (CENSUS 2023)

As a fundamental factor for estimating the energy consumption in the housing sector, the number of families[5] was used. These families were categorized according to climatic zones based on the indicator of heating degree-days. The division into 3 sub-sectors was made on the basis of the average number of annual heating degree-days, on which the energy requirements for heating and to some extent also for hot water depend. The urbanization of rural areas and the movement of rural families to urban areas have also been taken into consideration. Figures I-13 to I-15 present Albania administrative division based on the prefectures, municipalities and HDD concept. Tables I-3 - I-5 present the number of population and families for all Municipalities part of the Zone 1 as per Census 2023 data.

[5] The national statistics uses the term “families”, in the context of this report the term “family” can be used interchangeably with dwelling or household.

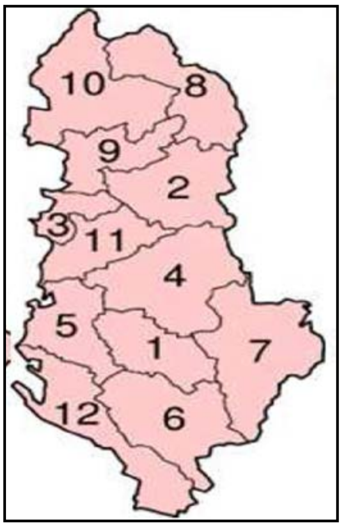


Figure I-13: Administrative breakdown of Albania prefectures

Figure I-14: Administrative breakdown of the Albanian municipalities

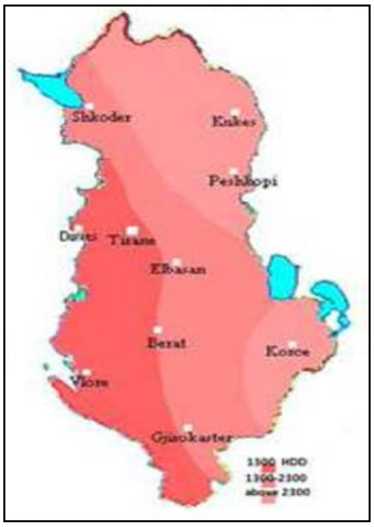


Figure I-15: Climatic Zones of Albania based on the HDD concept

Source: Energy Building Code, ex National Agency of Energy - 2003.

Table I-3: Population and families/ dwellings for all Municipalities part of the Zone 1

Climatic Zone	Nr	Municipality	Population	Number of Families
	1	Belsh	17,123	4,899
	2	Berat	62,232	17,205
	4	Cërrik	25,163	6,957
	5	Delvinë	6,166	1,705
	8	Divjakë	24,882	6,879
	10	Durrës	153,614	42,470
	11	Elbasan	115,101	31,822
	12	Fier	101,963	28,190
	13	Finiq	11,413	3,155
	18	Himarë	8,328	2,302
	19	Kamëz	96,137	26,579
	20	Kavajë	30,012	8,297
	24	Konispol	4,898	1,354
	27	Kuçovë	31,077	8,592
	29	Kurbin	34,405	9,512
	30	Lezhë	51,354	14,198
	33	Lushnjë	63,135	17,455
	40	Patos	18,227	5,039
	41	Peqin	16,580	4,584
	48	Roskovec	16,332	4,515
	49	Rrogozhinë	12,567	3,474
	50	Sarandë	22,613	6,252
	51	Selenicë	9,580	2,649
	52	Shijak	22,058	6,098
	56	Tiranë	598,176	181,265
	58	Ura Vajgurore	28,135	8,526
	60	Vlorë	83,683	25,358
Zone 1	61	Vorë	21,621	6,552

Table I-4: Population and families/dwellings for all Municipalities part of the Zone 2

Climatic Zone	Nr	Municipality	Population	Number of Families
	9	Dropull	8,259	2,775
	15	Gjirokastër	23,270	7,818
	16	Gramsh	16,533	5,555
	21	Këlcyrë	4,400	1,478
	22	Klos	12,172	4,089
	26	Krujë	51,191	17,198
	31	Libohovë	2,765	929
	32	Librazhd	23,312	7,832
	34	Malësi e Mad	21,684	7,285
	36	Mallakastër	15,838	5,321
	37	Mat	17,405	5,847
	38	Memaliaj	6,578	2,210
	39	Mirditë	13,625	4,578
	42	Përmet	7,980	2,681
	43	Pogradec	46,070	15,478
	44	Poliçan	8,762	2,944
	45	Përrenjas	18,768	6,305
	53	Shkodër	102,434	34,414
	54	Skrapar	10,750	3,612
	55	Tepelenë	6,761	2,271
Zone 2	59	Vau i Dejës	19,261	6,471

Table I-5: Population and families/dwellings for all Municipalities part of the Zone 3

Climatic Zone	Nr	Municipality	Population	Number of Families
	25	Korçë	60,754	20,411
	6	Devoll	25,897	7,160
	3	Bulqizë	26,826	9,543
	7	Dibër	50,775	17,059
	14	Fushë-Arrës	4,878	1,639
	17	Has	11,684	3,925
	23	Kolonjë	7,519	2,526
	28	Kukës	36,125	12,137
	35	Maliq	31,008	11,030
	46	Pukë	6,222	2,213
	47	Pustec	1,843	656
Zone 3	57	Tropojë	14,189	5,047

Source: Prepared by the Consultant based on INSTAT Census 2023

Step 2: Residential dwellings forecast is based on Long Term Building Renovation Action Plan for the period 2023-2050 prepared by the consultant team. Results for the whole Albanian residential building stock for each building category are presented at Figures I-16 - I-19.

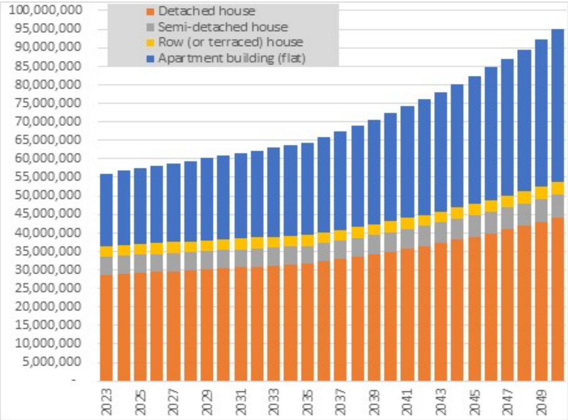


Figure I-16: Total forecasted areas (m²) of occupied dwellings for whole Albania according to the residential buildings

Source: Calculations performed by the Consultant

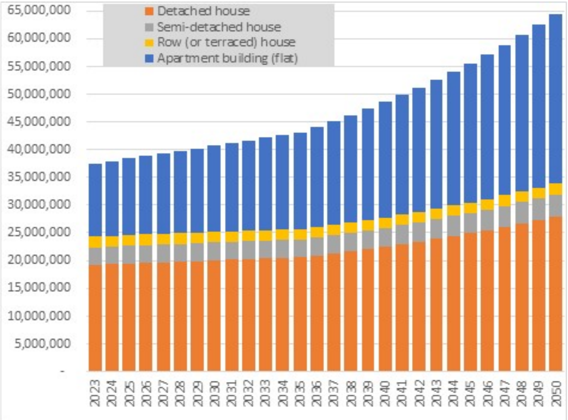


Figure I-17: Total forecasted floor area (m²) of occupied dwellings for Zone 1 according to the different residential building categories

Source: Calculations performed by the Consultant

Figure I-18: Total forecasted floor area (m²) of occupied dwellings for Zone 2 according to the different residential building categories

Source: Calculations performed by the Consultant

Figure I-19: Total forecasted floor area (m²) of occupied dwellings for Zone 3 according to the different residential building categories

Source: Calculations performed by the Consultant

Step 3: Shares of Energy Commodities (EC) for each residential building sub-category under each climatic zone for 2023 are based on the figures of the Yearly Energy Balance and are calculated by the consultant and expressed in %. Forecasted of share of the energy commodities, for each residential building sub-category under each climatic zone, for baseline scenario (BLS) are based on the assumptions undertaken under the Strategy of Energy, LTBRAP and revised document of NECP. All respective figures and assumptions are presented at Table I-6.

Table I-6: Breakdown of total residential energy commodities on building categories for each climatic zone

Energy Commodities (EC)	Values of EC for 2023, GWh	Shares of EC for 2023, %	Forecasted of EC for BLS for 2050, %	Values of EC for 2023, GWh	Shares of EC for 2023, %	Forecasted of EC for BLS for 2050, %
Zone 1: Detached house				Zone 1: Semi-detached house		
Solid fuels	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Natural Gas	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Oil by Products	421.05	21.37%	25.80%	51.40	22.24%	26.85%
Fuelwood	383.60	19.47%	23.50%	40.70	17.61%	21.27%
Electricity	1118.26	56.75%	47.79%	133.14	57.62%	48.84%
Solar Energy	47.44	2.41%	2.91%	5.81	2.52%	3.04%
Derived Heat	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Zone 1: Row (or terraced) house				Zone 1: Multi Apartment Buildings (MABs)		
Solid fuels	0.00%	0.00%	0.00%	0.00	0.00%	0.00%
Natural Gas	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Oil by Products	30.00	22.73%	27.44%	201.74	23.15%	27.95%
Fuelwood	14.53	11.01%	13.29%	53.95	6.19%	7.47%
Electricity	84.07	63.69%	56.17%	592.79	68.03%	61.40%
Solar Energy	3.38	2.56%	3.09%	22.92	2.63%	3.18%
Derived Heat	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Zone 2: Detached house				Zone 2: Semi-detached house		
Solid fuels	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Natural Gas	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Oil by Products	175.70	21.52%	25.98%	22.09	22.32%	26.95%
Fuelwood	205.12	25.12%	30.33%	36.63	37.01%	44.68%
Electricity	415.93	50.95%	40.78%	37.79	38.19%	25.38%
Solar Energy	19.66	2.41%	2.91%	2.45	2.48%	2.99%
Derived Heat	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Zone 2: Row (or terraced) house				Zone 2: Multi Apartment Buildings (MABs)		
Solid fuels	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Natural Gas	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Oil by Products	13.37	22.86%	27.60%	82.79	23.17%	27.97%
Fuelwood	20.93	35.78%	43.19%	56.98	15.94%	19.25%
Electricity	22.67	38.76%	26.07%	208.14	58.25%	49.59%
Solar Energy	1.52	2.60%	3.14%	9.43	2.64%	3.19%
Derived Heat	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Zone 3: Detached house				Zone 3: Semi-detached house		
Solid fuels	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Natural Gas	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Oil by Products	84.42	10.53%	12.71%	10.23	10.21%	12.32%
Fuelwood	330.93	41.26%	49.82%	25.00	24.94%	30.11%
Electricity	379.53	47.32%	36.41%	63.37	63.23%	55.60%
Solar Energy	7.10	0.89%	1.07%	1.63	1.62%	1.96%
Derived Heat	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Zone 3: Row (or terraced) house				Zone 3: Multi Apartment Buildings (MABs)		
Solid fuels	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Natural Gas	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Oil by Products	6.16	10.13%	12.23%	36.86	10.41%	12.57%
Fuelwood	11.74	19.31%	23.31%	124.53	35.18%	42.48%
Electricity	41.98	69.02%	62.61%	186.74	52.76%	42.97%
Solar Energy	0.93	1.53%	1.85%	5.81	1.64%	1.98%
Derived Heat	0.00	0.00%	0.00%	0.00	0.00%	0.00%

Source: Calculated by the Consultant

Step 4: Breakdown of energy commodities for each of the residential building sub-categories under each climatic zone on the respective energy services: 1) Space Heating; 2) Domestic Hot Water (DHW); 3) Space Cooling; 4) Cooking; 5) Lighting; and 6) Electrical Appliances are presented for each scenario at the Table I-7. Forecasted of share of the energy services, for each residential building sub-category under each climatic zone are based on the calculations of each respective referent residential analysed under the LTBRAP.

Table I-7: Actual and forecast shares for each energy service, for residential building categories for each zone, for three scenarios

Energy Services (ES)	Values of ES for 2023, GWh	Shares of ES for 2023, %	Forecasted of ES for BLS for 2050, %	Values of ES for 2023, GWh	Shares of ES for 2023, %	Forecasted of ES for BLS for 2050, %
Zone 1: Detached house				Zone 1: Semi-detached house		
Space Heating	953.50	48.39%	44.62%	109.62	47.45%	43.75%
DHW	240.10	12.19%	12.86%	29.36	12.71%	13.41%
Cooling	328.48	16.67%	21.54%	37.85	16.38%	21.20%
Cooking	228.21	11.58%	10.68%	27.91	12.08%	11.14%
Lighting	98.34	4.99%	4.60%	11.42	4.94%	4.56%
El. Appliances	121.71	6.18%	5.70%	14.88	6.44%	5.94%
Zone 1: Row (or terraced) house				Zone 1: Multi Apartment Buildings (MABs)		
Space Heating	56.09	42.50%	39.18%	409.09	46.95%	43.29%
DHW	21.36	16.18%	17.08%	132.04	15.15%	15.99%
Cooling	11.91	9.02%	13.96%	86.05	9.88%	14.88%
Cooking	20.31	15.39%	14.19%	125.53	14.41%	13.28%
Lighting	11.49	8.70%	8.02%	74.56	8.56%	7.89%
El. Appliances	10.83	8.21%	7.57%	44.13	5.06%	4.67%
Zone 2: Detached house				Zone 2: Semi-detached house		
Space Heating	466.32	57.12%	52.67%	47.89	48.39%	44.62%
DHW	85.73	10.50%	11.08%	12.06	12.19%	12.86%
Cooling	89.40	10.95%	16.49%	16.50	16.67%	21.54%
Cooking	90.53	11.09%	10.23%	11.46	11.58%	10.68%
Lighting	36.09	4.42%	4.08%	4.94	4.99%	4.60%
El. Appliances	48.28	5.91%	5.45%	6.11	6.18%	5.70%
Zone 2: Row (or terraced) house				Zone 2: Multi Apartment Buildings (MABs)		
Space Heating	29.43	50.32%	46.40%	206.43	57.77%	53.27%
DHW	8.09	13.83%	14.60%	43.50	12.17%	12.85%
Cooling	3.44	5.88%	11.37%	23.87	6.68%	12.33%
Cooking	8.55	14.61%	13.47%	41.36	11.57%	10.67%
Lighting	4.43	7.57%	6.98%	27.63	7.73%	7.13%
El. Appliances	4.56	7.79%	7.18%	14.54	4.07%	3.75%
Zone 3: Detached house				Zone 3: Semi-detached house		
Space Heating	376.50	46.95%	43.29%	68.56	68.40%	63.07%
DHW	121.52	15.15%	15.99%	8.82	8.80%	9.28%
Cooling	79.20	9.88%	14.88%	5.60	5.58%	11.77%
Cooking	115.53	14.41%	13.28%	8.89	8.87%	8.18%
Lighting	68.62	8.56%	7.89%	3.62	3.61%	3.33%
El. Appliances	40.61	5.06%	4.67%	4.74	4.73%	4.36%
Zone 3: Row (or terraced) house				Zone 3: Multi Apartment Buildings (MABs)		
Space Heating	38.48	63.28%	58.35%	251.82	71.14%	65.60%
DHW	6.50	10.70%	11.29%	29.43	8.31%	8.78%
Cooling	2.14	3.52%	9.62%	13.85	3.91%	10.29%
Cooking	6.56	10.79%	9.95%	27.98	7.91%	7.29%
Lighting	3.62	5.96%	5.49%	21.04	5.94%	5.48%
El. Appliances	3.50	5.75%	5.30%	9.84	2.78%	2.56%

Source: Calculated by the Consultant

Step 5: Forecast of energy demand for residential sector up to 2050 is calculated based on the energy intensities for all energy commodities according to the energy strategy for the period 2023-2050 for each referent building under each climatic zone. The respective energy intensity values of the energy services for period 2023-2050 are presented at the Table I-8.

Table I-8: Actual and forecasted energy intensity values on residential sector (kWh/m2)

Sub-residential sector	2023	2030	2035	2040	2045	2050
ZONE 1	**85.519**	**82.194**	**79.818**	**77.442**	**75.067**	**72.691**
Detached house	102.585	98.595	95.746	92.896	90.046	87.197
Semi-detached house	72.990	70.152	68.124	66.097	64.069	62.042
Row (or terraced) house	68.734	66.061	64.152	62.242	60.333	58.424
Apartment building (flat)	66.105	63.535	61.698	59.862	58.026	56.190
ZONE 2	**116.955**	**112.407**	**109.158**	**105.91**	**102.661**	**99.412**
Detached house	140.378	134.919	131.019	127.12	123.221	119.321
Semi-detached house	99.813	95.931	93.158	90.386	87.613	84.841
Row (or terraced) house	93.984	90.329	87.718	85.107	82.497	79.886
Apartment building (flat)	90.429	86.912	84.400	81.888	79.376	76.864
ZONE 3	**180.997**	**173.958**	**168.931**	**163.90**	**158.875**	**153.847**
Detached house	216.570	208.148	202.132	196.11	190.100	184.085
Semi-detached house	154.495	148.487	144.195	139.90	135.612	131.321
Row (or terraced) house	145.582	139.921	135.877	131.83	127.789	123.745
Apartment building (flat)	140.721	135.248	131.339	127.43	123.521	119.612
TOTAL	104.179	99.875	96.814	93.627	90.429	87.222

Source: Calculated by the Consultant

Step 6: Carry out the Final Energy Demand Forecast, for each energy commodity, for each residential building subcategory and for each climatic zone based on the formula:

> $EnergyComm._{demand}$ = activity level x share of energy commodity x energy intensity for each residential building subcategory and for each climatic zone.

Calculation of final energy demand was carried out based on the entire data mentioned on all steps above for each building sub-category, each energy service and the respective values are presented at the Table I-9.

Table I-9: Forecast final energy demand (GWh/year), for residential building category, under each climatic zone and for each scenario

Residential sector	2023	2030	2035	2040	2045	2050
ZONE 1						
Detached house						
Solid fuels	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00
Oil by Products	421.05	442.91	457.57	502.61	559.11	629.07
Fuelwood	383.60	403.52	416.88	457.92	509.39	573.13
Electricity	1118.26	1077.55	1043.32	1071.87	1112.71	1165.39
Solar Energy	47.44	49.91	51.56	56.63	63.00	70.88
Derived Heat	0.00	0.00	0.00	0.00	0.00	0.00
Semi-detached house						
Solid fuels	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00
Oil by Products	51.40	52.81	53.08	56.57	60.87	65.02
Fuelwood	40.70	41.82	42.03	44.79	48.20	51.49
Electricity	133.14	125.50	118.34	118.10	118.76	118.26
Solar Energy	5.81	5.97	6.00	6.40	6.89	7.36
Derived Heat	0.00	0.00	0.00	0.00	0.00	0.00
Row (or terraced) house						
Solid fuels	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00
Oil by Products	30.00	29.35	28.59	29.37	30.26	31.13
Fuelwood	14.53	14.22	13.85	14.23	14.66	15.08
Electricity	84.07	76.11	70.01	67.85	65.86	63.72
Solar Energy	3.38	3.31	3.22	3.31	3.41	3.51
Derived Heat	0.00	0.00	0.00	0.00	0.00	0.00
Apartment building (flat)						
Solid fuels	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00
Oil by Products	201.74	240.80	271.55	324.89	392.95	480.09
Fuelwood	53.95	64.40	72.62	86.89	105.09	128.39
Electricity	592.79	657.98	703.72	797.71	913.15	1054.67
Solar Energy	22.92	27.36	30.85	36.91	44.64	54.54
Derived Heat	0.00	0.00	0.00	0.00	0.00	0.00
ZONE 2						
Detached house						
Solid fuels	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00

Oil by Products	175.70	191.00	201.85	225.66	255.39	291.33
Fuelwood	205.12	222.98	235.65	263.44	298.15	340.11
Electricity	415.93	409.87	402.53	416.95	435.75	457.28
Solar Energy	19.66	21.38	22.59	25.25	28.58	32.60
Derived Heat	0.00	0.00	0.00	0.00	0.00	0.00
Semi-detached house						
Solid fuels	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00
Oil by Products	22.09	23.24	24.01	26.22	28.96	32.29
Fuelwood	36.63	38.54	39.81	43.47	48.02	53.54
Electricity	37.79	34.80	32.44	31.72	31.09	30.41
Solar Energy	2.45	2.58	2.67	2.91	3.22	3.59
Derived Heat	0.00	0.00	0.00	0.00	0.00	0.00
Row (or terraced) house						
Solid fuels	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00
Oil by Products	13.37	13.70	14.32	15.84	17.74	20.98
Fuelwood	20.93	21.44	22.42	24.80	27.76	32.83
Electricity	22.67	20.37	19.26	19.11	19.04	19.82
Solar Energy	1.52	1.56	1.63	1.80	2.02	2.39
Derived Heat	0.00	0.00	0.00	0.00	0.00	0.00
Apartment building (flat)						
Solid fuels	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00
Oil by Products	82.79	93.09	100.68	115.15	133.28	155.40
Fuelwood	56.98	64.07	69.29	79.25	91.72	106.94
Electricity	208.14	214.89	218.22	233.91	253.23	275.53
Solar Energy	9.43	10.60	11.47	13.12	15.18	17.70
Derived Heat	0.00	0.00	0.00	0.00	0.00	0.00
ZONE 3						
Detached house						
Solid fuels	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00
Oil by Products	84.42	94.73	102.79	117.27	135.40	157.83
Fuelwood	330.93	371.35	402.93	459.73	530.77	618.71
Electricity	379.53	383.01	383.70	402.66	425.73	452.19
Solar Energy	7.10	7.97	8.65	9.87	11.39	13.28
Derived Heat	0.00	0.00	0.00	0.00	0.00	0.00
Semi-detached house						
Solid fuels	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00
Oil by Products	10.23	9.84	10.13	10.95	11.97	14.12
Fuelwood	25.00	24.03	24.74	26.75	29.24	34.49
Electricity	63.37	56.32	54.75	55.82	57.45	63.69
Solar Energy	1.63	1.56	1.61	1.74	1.90	2.25
Derived Heat	0.00	0.00	0.00	0.00	0.00	0.00
Row (or terraced) house						
Solid fuels	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00
Oil by Products	6.16	6.26	6.24	6.53	6.89	6.69
Fuelwood	11.74	11.93	11.89	12.44	13.13	12.74
Electricity	41.98	39.69	37.56	37.26	37.25	34.21
Solar Energy	0.93	0.94	0.94	0.99	1.04	1.01
Derived Heat	0.00	0.00	0.00	0.00	0.00	0.00
Apartment building (flat)						
Solid fuels	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00
Oil by Products	36.86	39.03	40.66	44.20	48.26	52.54
Fuelwood	124.53	131.87	137.37	149.33	163.06	177.51
Electricity	186.74	179.89	174.63	176.46	178.58	179.58
Solar Energy	5.81	6.16	6.41	6.97	7.61	8.29
Derived Heat	0.00	0.00	0.00	0.00	0.00	0.00

Source: Calculated by the Consultant

Step 7: Carry out the Final Energy Demand Forecast for each energy service category: 1) Space Heating; 2) Domestic Hot Water (DHW); 3) Space Cooling; 4) Cooking; 5) Lighting; and 6) Electrical Appliances for each residential building subcategory and for each climatic zone based on the formula:

> $EnergyService_{demand}$ = activity level x share of energy service x energy intensity for each residential building subcategory and for each climatic zone.

Calculation of final energy service demand was carried out based on the entire data mentioned on all steps above for each building sub-category, for each energy service and the respective values are presented at the Table I-10.

Table I-10: Forecast final energy demand (GWh/year), for each energy service, for each residential buildings categories, under each climatic zone and for baseline scenario

Residential sector	2023	2030	2035	2040	2045	2050
ZONE 1						
Detached house						
Space Heating	953.50	935.33	919.26	960.60	1016.56	1088.09
DHW	240.10	243.92	245.80	263.36	285.77	313.62
Cooling	328.48	354.91	372.11	413.48	463.97	525.23
Cooking	228.21	223.86	220.02	229.91	243.30	260.42
Lighting	98.34	96.46	94.81	99.07	104.84	112.22
El. Appliances	121.71	119.39	117.34	122.62	129.76	138.89
Semi-detached house						
Space Heating	109.62	105.05	100.43	101.83	104.24	105.93
DHW	29.36	29.14	28.57	29.70	31.17	32.48
Cooling	37.85	39.98	40.79	43.99	47.76	51.34
Cooking	27.91	26.74	25.57	25.92	26.54	26.97
Lighting	11.42	10.94	10.46	10.61	10.86	11.03
El. Appliances	14.88	14.26	13.64	13.83	14.15	14.38
Row (or terraced) house						
Space Heating	56.09	51.18	47.41	46.34	45.43	44.45
DHW	21.36	20.19	19.17	19.21	19.31	19.38
Cooling	11.91	12.73	13.05	13.99	14.94	15.83
Cooking	20.31	18.53	17.17	16.78	16.45	16.10
Lighting	11.49	10.48	9.71	9.49	9.30	9.10
El. Appliances	10.83	9.88	9.16	8.95	8.77	8.58
Apartment building (flat)						
Space Heating	409.09	455.34	488.49	556.00	639.74	743.56
DHW	132.04	152.21	167.42	195.39	230.51	274.70
Cooling	86.05	111.16	131.20	163.09	203.66	255.54
Cooking	125.53	139.73	149.90	170.61	196.31	228.17
Lighting	74.56	82.99	89.03	101.33	116.60	135.52
El. Appliances	44.13	49.12	52.69	59.97	69.01	80.21
ZONE 2						
Detached house						
Space Heating	466.32	472.73	475.26	505.46	544.20	590.57
DHW	85.73	90.01	92.79	101.18	111.69	124.28
Cooling	89.40	105.18	116.31	135.09	157.86	184.96
Cooking	90.53	91.78	92.27	98.13	105.65	114.66
Lighting	36.09	36.59	36.78	39.12	42.12	45.71
El. Appliances	48.28	48.94	49.20	52.33	56.34	61.14
Semi-detached house						
Space Heating	47.89	46.99	46.18	47.97	50.41	53.47
DHW	12.06	12.25	12.35	13.15	14.17	15.41
Cooling	16.50	17.83	18.69	20.65	23.01	25.81
Cooking	11.46	11.25	11.05	11.48	12.06	12.80
Lighting	4.94	4.85	4.76	4.95	5.20	5.51
El. Appliances	6.11	6.00	5.89	6.12	6.43	6.83
Row (or terraced) house						
Space Heating	29.43	28.11	27.97	29.43	31.35	35.27
DHW	8.09	8.00	8.17	8.81	9.62	11.10
Cooling	3.44	4.19	4.83	5.78	6.92	8.64
Cooking	8.55	8.16	8.12	8.55	9.10	10.24
Lighting	4.43	4.23	4.21	4.43	4.72	5.31
El. Appliances	4.56	4.35	4.33	4.56	4.85	5.46
Apartment building (flat)						
Space Heating	206.43	216.45	222.70	242.31	266.81	295.94
DHW	43.50	47.24	49.83	55.59	62.77	71.38
Cooling	23.87	31.37	37.01	45.47	55.88	68.50
Cooking	41.36	43.37	44.62	48.55	53.46	59.29
Lighting	27.63	28.98	29.81	32.44	35.72	39.62
El. Appliances	14.54	15.24	15.68	17.06	18.79	20.84
ZONE 3						
Detached house						
Space Heating	376.50	393.99	406.68	441.42	484.82	537.65
DHW	121.52	131.70	139.38	155.12	174.69	198.63
Cooling	79.20	96.18	109.23	129.48	154.34	184.77
Cooking	115.53	120.90	124.79	135.45	148.77	164.98
Lighting	68.62	71.81	74.12	80.45	88.36	97.99

El. Appliances	40.61	42.50	43.87	47.62	52.30	58.00
Semi-detached house						
Space Heating	376.50	393.99	406.68	441.42	484.82	537.65
DHW	121.52	131.70	139.38	155.12	174.69	198.63
Cooling	79.20	96.18	109.23	129.48	154.34	184.77
Cooking	115.53	120.90	124.79	135.45	148.77	164.98
Lighting	68.62	71.81	74.12	80.45	88.36	97.99
El. Appliances	40.61	42.50	43.87	47.62	52.30	58.00
Row (or terraced) house						
Space Heating	68.56	61.45	60.19	61.91	64.38	72.24
DHW	8.82	8.18	8.22	8.67	9.24	10.64
Cooling	5.60	6.65	7.67	9.10	10.73	13.49
Cooking	8.89	7.97	7.81	8.03	8.35	9.37
Lighting	3.62	3.25	3.18	3.27	3.40	3.82
El. Appliances	4.74	4.25	4.16	4.28	4.45	5.00
Apartment building (flat)						
Space Heating	251.82	248.66	246.41	254.83	264.72	274.16
DHW	29.43	30.10	30.58	32.43	34.54	36.68
Cooling	13.85	20.07	24.49	30.14	36.39	43.01
Cooking	27.98	27.63	27.38	28.32	29.41	30.46
Lighting	21.04	20.77	20.59	21.29	22.12	22.90
El. Appliances	9.84	9.71	9.62	9.95	10.34	10.71

Source: Calculated by the Consultant

Step 8: Useful energy for each energy service category: 1) Space Heating; 2) Domestic Hot Water (DHW); 3) Space Cooling; 4) Cooking; 5) Lighting; and 6) Electrical Appliances for each residential building subcategory is calculated based on final energy (calculated under step 7) multiplied with average efficiencies for group of technical systems (table I-11), used under each building category, under each climatic zone. Average efficiencies for technical systems assumed are based on energy surveys carried out for the residential sector by the AEE and figures used under National Strategy of Energy and NECP.

Table I-11: Average efficiencies for technical systems, for residential building category, under each climatic zone and for each scenario

Buildings Categories	Average Space Heating Efficiency Technical Systems:							Average Water Heating Eff. Tech. Systems	Average Water Heating Eff. Tech. Systems Cooling	Average Cooking Eff. Tech. Systems	Average Lighting Eff. Tech. Systems	Average Elec. Appl. Eff. Tech. Systems
	Elect. AC split unit	Elect. Heaters	Diesel	LPG	Wood	Pellet	Aggr. Effic.					
Zone 1												
Detached house	92%	100%	85.0%	88.0%	50.0%	70.0%	85.4%	92.8%	92.0%	84.3%	96.6%	87.4%
Semi-detached house	92%	100%	85.0%	88.0%	50.0%	70.0%	86.2%	92.8%	92.0%	85.0%	96.6%	87.4%
Row (or terraced) house	92%	100%	85.0%	88.0%	50.0%	70.0%	89.1%	92.8%	92.0%	88.0%	96.6%	87.4%
Apartment building (flat)	92%	100%	85.0%	88.0%	50.0%	70.0%	91.1%	92.8%	92.0%	90.1%	96.6%	87.4%
Zone 2	92%	100%										
Detached house	90%	100%	82.0%	85.0%	45.0%	65.0%	80.5%	90.7%	90.0%	78.7%	94.5%	85.5%
Semi-detached house	90%	100%	82.0%	85.0%	45.0%	65.0%	74.7%	90.7%	90.0%	72.7%	94.5%	85.5%
Row (or terraced) house	90%	100%	82.0%	85.0%	45.0%	65.0%	75.2%	90.7%	90.0%	73.3%	94.5%	85.5%
Apartment building (flat)	90%	100%	82.0%	85.0%	45.0%	65.0%	84.7%	90.7%	90.0%	83.0%	94.5%	85.5%
Zone 3	90%	100%										
Detached house	88%	100%	80.0%	82.0%	40.0%	62.0%	71.3%	88.4%	88.0%	69.5%	92.4%	83.6%
Semi-detached house	88%	100%	80.0%	82.0%	40.0%	62.0%	79.2%	88.4%	88.0%	78.9%	92.4%	83.6%
Row (or terraced) house	88%	100%	80.0%	82.0%	40.0%	62.0%	82.0%	88.4%	88.0%	82.8%	92.4%	83.6%
Apartment building (flat)	88%	100%	80.0%	82.0%	40.0%	62.0%	74.6%	88.4%	88.0%	72.5%	92.4%	83.6%

Calculation of useful energy service demand was carried out, for each building sub-category, for each climatic zone and the respective values are presented at the Table I-12.

Table I-12: Forecast useful energy demand (GWh/year), for each energy service, for each residential buildings categories, under each climatic zone and for baseline scenario

Residential sector	2023	2030	2035	2040	2045	2050
ZONE 1						
Detached house						
Space Heating	814.62	799.10	785.37	820.68	868.50	929.61
DHW	222.82	226.36	228.11	244.40	265.19	291.04
Cooling	302.20	326.52	342.34	380.40	426.85	483.21
Cooking	192.28	188.62	185.38	193.71	205.00	219.42
Lighting	94.99	93.18	91.58	95.70	101.28	108.40
El. Appliances	106.38	104.35	102.56	107.17	113.41	121.39
Semi-detached house						
Space Heating	94.46	90.52	86.54	87.75	89.83	91.28
DHW	27.25	27.04	26.51	27.56	28.93	30.14
Cooling	34.83	36.78	37.52	40.47	43.94	47.23
Cooking	23.72	22.73	21.73	22.03	22.55	22.92
Lighting	11.03	10.57	10.10	10.24	10.49	10.66
El. Appliances	13.01	12.47	11.92	12.08	12.37	12.57
Row (or terraced) house						
Space Heating	49.98	45.60	42.25	41.29	40.48	39.61
DHW	19.82	18.73	17.79	17.83	17.92	17.98
Cooling	10.96	11.72	12.00	12.87	13.74	14.56
Cooking	17.87	16.31	15.11	14.77	14.48	14.17
Lighting	11.10	10.12	9.38	9.17	8.99	8.79
El. Appliances	9.47	8.64	8.00	7.82	7.67	7.50
Apartment building (flat)						
Space Heating	372.72	414.85	445.06	506.56	582.86	677.45
DHW	122.53	141.25	155.37	181.32	213.91	254.92
Cooling	79.17	102.27	120.70	150.04	187.37	235.10
Cooking	113.15	125.94	135.11	153.78	176.94	205.66
Lighting	72.02	80.17	86.00	97.89	112.63	130.91
El. Appliances	38.57	42.93	46.05	52.42	60.31	70.10
ZONE 2						
Detached house						
Space Heating	375.19	380.35	382.39	406.68	437.85	475.16
DHW	77.76	81.64	84.16	91.77	101.31	112.72
Cooling	80.46	94.66	104.68	121.58	142.07	166.46
Cooking	71.22	72.20	72.59	77.20	83.12	90.20
Lighting	28.39	28.78	28.94	30.78	33.13	35.96
El. Appliances	41.28	41.85	42.07	44.74	48.17	52.28
Semi-detached house						
Space Heating	35.76	35.08	34.48	35.82	37.63	39.92
DHW	10.94	11.11	11.20	11.93	12.85	13.98
Cooling	14.85	16.05	16.82	18.58	20.71	23.23
Cooking	8.33	8.18	8.03	8.35	8.77	9.30
Lighting	4.67	4.58	4.50	4.68	4.91	5.21
El. Appliances	5.23	5.13	5.04	5.24	5.50	5.84
Row (or terraced) house						
Space Heating	22.15	21.15	21.04	22.15	23.59	26.54
DHW	7.34	7.26	7.41	7.99	8.73	10.07
Cooling	3.09	3.78	4.35	5.21	6.22	7.78
Cooking	6.26	5.98	5.95	6.26	6.67	7.50
Lighting	4.19	4.00	3.98	4.19	4.46	5.02
El. Appliances	3.90	3.72	3.70	3.90	4.15	4.67
Apartment building (flat)						
Space Heating	174.78	183.27	188.56	205.16	225.91	250.57
DHW	39.46	42.85	45.20	50.42	56.93	64.74
Cooling	21.49	28.24	33.31	40.93	50.29	61.65
Cooking	34.33	35.99	37.03	40.29	44.37	49.21
Lighting	26.11	27.38	28.17	30.65	33.75	37.44
El. Appliances	12.43	13.03	13.41	14.59	16.07	17.82
ZONE 3						
Detached house						
Space Heating	268.62	281.10	290.15	314.94	345.90	383.59
DHW	107.38	116.37	123.16	137.06	154.35	175.51
Cooling	69.69	84.64	96.12	113.94	135.82	162.60
Cooking	80.33	84.06	86.77	94.18	103.45	114.72
Lighting	63.40	66.35	68.49	74.34	81.64	90.54
El. Appliances	33.95	35.53	36.67	39.81	43.72	48.48
Semi-detached house						
Space Heating	54.28	48.66	47.66	49.02	50.98	57.20
DHW	7.79	7.23	7.26	7.66	8.17	9.40

Cooling	4.93	5.85	6.75	8.00	9.44	11.87
Cooking	7.01	6.29	6.16	6.33	6.59	7.39
Lighting	3.35	3.00	2.94	3.02	3.14	3.53
El. Appliances	3.97	3.55	3.48	3.58	3.72	4.18
Row (or terraced) house						
Space Heating	31.55	29.88	28.34	28.21	28.31	26.14
DHW	5.75	5.64	5.48	5.60	5.76	5.45
Cooling	1.89	2.67	3.14	3.74	4.38	4.62
Cooking	5.43	5.14	4.88	4.86	4.87	4.50
Lighting	3.35	3.17	3.01	2.99	3.00	2.77
El. Appliances	2.92	2.77	2.63	2.62	2.62	2.42
Apartment building (flat)						
Space Heating	187.88	185.52	183.84	190.13	197.50	204.55
DHW	26.01	26.59	27.02	28.65	30.52	32.41
Cooling	12.19	17.66	21.55	26.53	32.02	37.85
Cooking	20.29	20.04	19.86	20.54	21.33	22.09
Lighting	19.44	19.20	19.02	19.67	20.44	21.16
El. Appliances	8.22	8.12	8.05	8.32	8.64	8.95

Source: Calculated by the Consultant

Albania is using the following definitions in the context of poverty and energy poverty: Albania's legal framework for protecting vulnerable consumers (VCs) is grounded in the Power Sector Law and Natural Gas Sector Law. These acts provide criteria for defining vulnerable consumers, focusing on low-income dwellings, and address the procedures for granting vulnerable consumer status. The government has outlined these criteria in Council of Ministers Decision No. 8 (2015).

Vulnerable consumers are defined as *"families of budget employees, with a gross monthly salary below 35,000 LEK per month, when the employee is the head of dwelling and has no employed or self-employed family members"*

Vulnerability in the current framework refers to a disability, health, and income status. Though the current definition benefits the most vulnerable members of society, however it does not capture the broader aspects of energy poverty.

Statistical data on the number of vulnerable consumers are available on a municipal level, but not reported officially on a national level.

At risk of poverty: According to the Albania's National Statistical Office (INSTAT) the "at-risk-of-poverty" threshold is assessed and published on an annual basis. INSTAT applies the following definition for "at risk of poverty":

"The at risk of poverty threshold is defined as 60% of the median equivalised disposable income for all dwellings". This means that individuals are considered at risk of poverty if their dwelling's equivalent disposable income falls below this threshold. INSTAT publishes the main results of the Income and Living Conditions Survey (EU- SILC) which measures living conditions, relative poverty and material deprivation of Albanian dwellings. The main indicators for monitoring relative poverty, income distribution and other indicators of the living conditions are based on the objective of the Europe 2030 agenda.

Albania's economic growth, measured by real GDP per capita, has been relatively high compared to the average of Energy Community Contracting Parties (EnC CPs). Between 2013 and 2024, Albania saw a 100% increase in GDP, which is higher compare with the average growth rate in EnC CPs. The unemployment rate in Albania has consistently been between 10% and 12% for both men and women over the last decade, with no significant gender disparities in this regard. The unemployment rate has stabilized in recent years. Wage growth in Albania between 2014 and 2024 was moderate/high, at just 30-35%, while EnC CPs saw an average increase of 26%. Following table I-13 presents the main data of general poverty according to the INSTAT Income and Living Conditions Survey based on the WB Methodology for 2021, 2022 and 2023.

Table I-13: Risk of Poverty and Social Exclusion Indicators for Albania

Indicators	2021	2022	2023
Potential risk of poverty rate (%)	**22%**	**20.6%**	**19%**
Persons severe deprived from material and social goods/services (%) (lack of 7 out of 13 categories of material deprivation)	39%	37%	34.8%

Very low work intensity (%) (age group 18-64)	11.7%	10.4%	9.13%
Risk of poverty income threshold (expressed in money terms (ALL/year); for the most conservative scenario - one person per dwelling (ALL/year)	191,791	225,931	270,565

Source: INSTAT - Income and Living Conditions Survey based on the WB Methodology for 2021, 2022 and 2023

In Albania, electricity, LPG and fuel wood are the final energy commodities for dwelling consumers. Natural gas and district heating (DH) systems are currently unavailable. However, there are plans to develop a gas transmission and distribution network in the medium term. The average Albanian dwelling consumes a combination of these energy sources, with electricity accounting for a major share. The total dwelling energy consumption is distributed across electricity, biomass, and LPG, with electricity being the most consumed energy type.

A rough estimate of the number of energy-poor dwellings in Albania is proposed using a combination of indicators. According to INSTAT data for December 2023 there are 545.000 inhabitants in Albania are at risk of poverty (app. 19% of the population). The income threshold that separated poverty in 2023 was 740 ALL per day or 22,200 ALL per month. The limit for being poor is considered monthly income of 22,200 ALL (225 euros). Nearly one in five individuals (i.e. approx. 20%) in Albania lives on the threshold of poverty. The data released by INSTAT for 2023 show that compared to 2022 (576,000 inhabitant), there is a decrease of 31,000 people living in difficult conditions.

Comparing the risk of poverty for 2023 between Albania and other countries in the region it shows that the highest value of relative poverty is recorded in Bulgaria (22.9%), Romania (21.2%), followed by Albania (20.6%). The lowest poverty rates are recorded in Slovenia (12.1%) and Hungary (12.1%), while the EU average (27 countries) amounts 16.5%.

Albania currently implements two primary short-term measures to support vulnerable consumers, specifically targeting low-income dwellings.

- Compensation for increases in electricity prices: This measure, introduced in 2006, provides a cash benefit of 640 ALL (EUR 6.5) per month to dwellings consuming up to 200 kWh per month. In 2015, the benefit was increased to 648 ALL (approx. EUR 6.75) for those consuming up to 300 kWh per month. These measures cover around 213,000 dwellings and the total costs amounts to around EUR 25 million per year.

- Compensation for Removal of the Protected Threshold of 300 kWh/month after January 2015 - Prior to 2015, low-income dwellings were charged a lower tariff for electricity consumption up to 300 kWh/month. However, this was replaced with a unified electricity price of 11.4 ALL/kWh (EUR 0.12 including VAT) in 2015. Vulnerable consumers were further protected by a 648 ALL (EUR 6.75) monthly cash benefit.

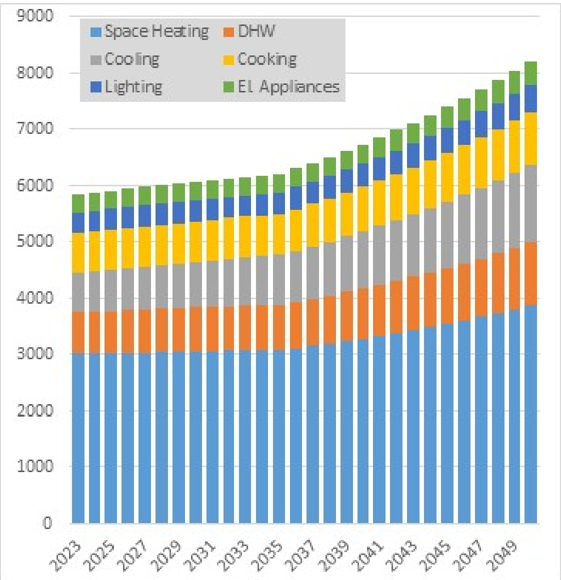
EECG team took into consideration social, gender and distributional impacts of all EE/RES heating and cooling measures proposed especially for the residential three climatic zones of Albania. EECG team in the second part of the project will be focus on measures focus on the most vulnerable groups, such as the women, disabled, retirees, and low-income individuals based on the state aid estimated, which is annually equal to EUR 22-25 million per year. The following all EE/RES heating and cooling measures proposed especially for the residential three climatic zones of Albania will be recommended to improve the situation:

- The ECG team will propose recommendation and measures as identified by the previous work of Expertise France and subsequent Action Plan for Energy poverty mitigation, including measures required by the newly adopted Law on Energy Performance in Building and in accordance with the ongoing work of the Inter-ministerial working group established under the Prime Minister order to revise the existing support scheme for vulnerable customers. The measures will be intended to move the support to the vulnerable groups and mitigate energy poverty from static safety net existing today to more market responsive safety net and preventive measures. The proposed recommendations will be layered to include direct financial subsidies, energy efficiency subsidies, protection against disconnection and overall raising the awareness of customers on the programs and measures to protect them against energy poverty.

- Long-Term Energy Poverty Mitigation Program: will be important to adopt a formal program that combines direct financial support with all EE/RES heating and cooling measures proposed especially for the residential three climatic zones of Albania and structural solutions to reduce energy poverty over the long term.
- Significant improvements in the residential buildings, particularly those relying on all EE/RES heating and cooling measures proposed especially for the residential three climatic zones of Albania, would help reduce overall energy demand, costs, reduce Energy Poverty Level (EPL) and brings energy savings and GHG reduction. EECG team has good experience in energy audits for single houses, Multi Apartment Buildings, public buildings and together with Energy Audit carried for Vlora Hospital under EFD-TA will use this experience to select EE measures, especially the low CAPEX and suitable for the buildings where are living vulnerable families.
- Subsidizing Appliance Replacement: Vulnerable dwellings often use old, inefficient appliances. A scheme to replace these appliances with new heating and cooling appliances could lead to more efficient energy use and reduce bills.
- Energy Advice and Education: Providing low-cost energy audits and energy-saving advice can help vulnerable consumers to reduce consumption and improve efficiency in their homes. More detail analysed will be carried during the preparation of the energy policy measures for supporting vulnerable families.
- Direct Financial Support: Existing financial measures should continue and should be increase 10% to cover the respective inflation of the last years and they should be targeted only at the most socially vulnerable groups.
- Low-Cost Energy Efficiency Advice and Measures: Implementing simple, low-cost of all EE/RES heating and cooling measures proposed especially for the residential three climatic zones of Albania, can significantly reduce energy demand in vulnerable dwellings.

Main conclusion of final and useful energy demand for the residential sector are as following:

- Total final energy demand is increased from 5,852.94 GWh (2023) to 8,213.61 GWh (2050) for baseline scenario (BLS) (figure I-20). Meanwhile, total useful energy demand is 7,059.81 GWh (2050) for BLS (figure I-21).
- Total final space heating energy demand is increased from 3,013.74 GWh (2023) to 3,873.22 GWh (2050) for BLS (figure I-22). Meanwhile, total useful space heating energy demand is 3,201.61 GWh (2050) for BLS (figure I-23).
- Total final space cooling energy demand is increased from 698.31 GWh (2023) to 1,382.37 GWh (2050) for BLS (figure I-24). Meanwhile, total useful space cooling energy demand is 1,256.16 GWh (2050) for BLS (figure I-25).
- Total final water heating energy demand is increased from 738.53 GWh (2023) to 1,114.46 GWh (2050) for BLS (figure I-26). Meanwhile, total useful water heating energy demand is 1,018.36 GWh (2050) for BLS (figure I-27).



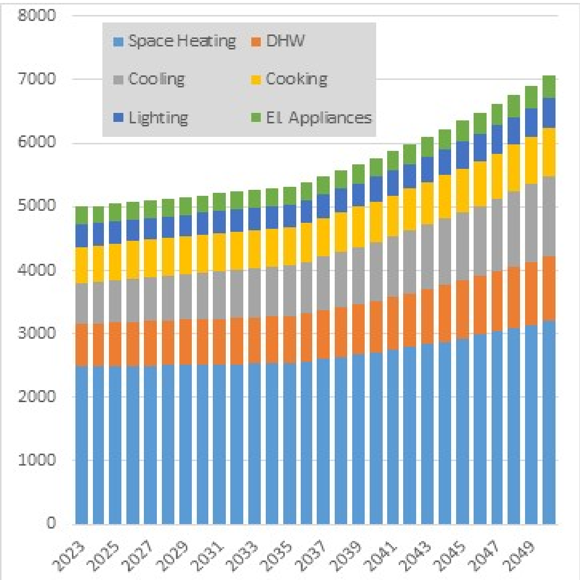
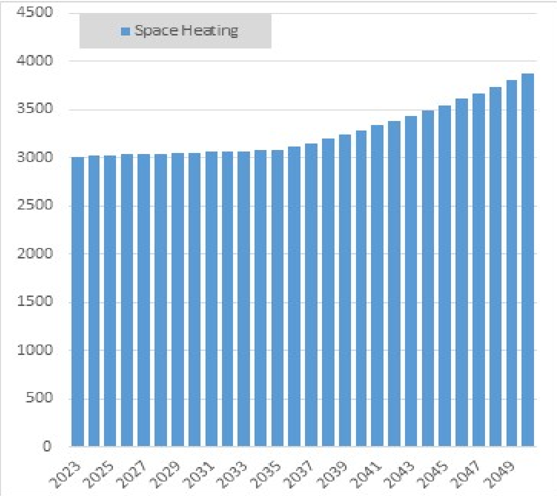


Figure I-20: Residential Final Energy Services forecast for Baseline (BL) Scenario, in GWh
Source: Calculated by the Consultant

Figure I-21: Residential Useful Energy Services forecast for BL Scenario, in GWh
Source: Calculated by the Consultant



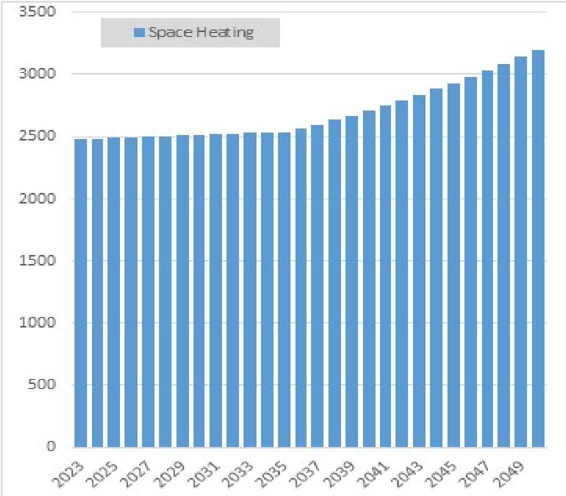
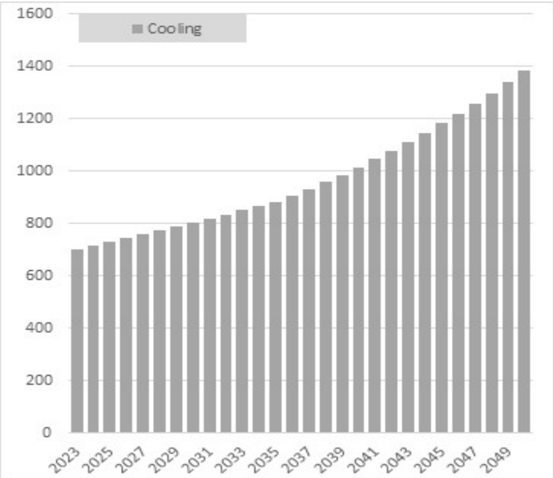


Figure I-22: Residential Final Energy Space Heating forecast for BL Scenario, in GWh
Source: Calculated by the Consultant

Figure I-23: Residential Useful Space Heating forecast for BL Scenario, in GWh
Source: Calculated by the Consultant



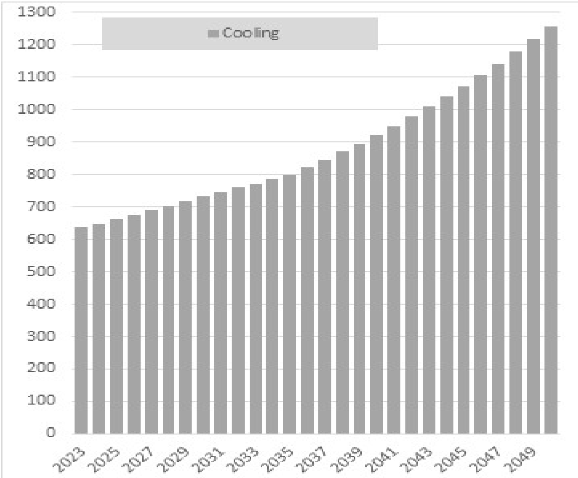
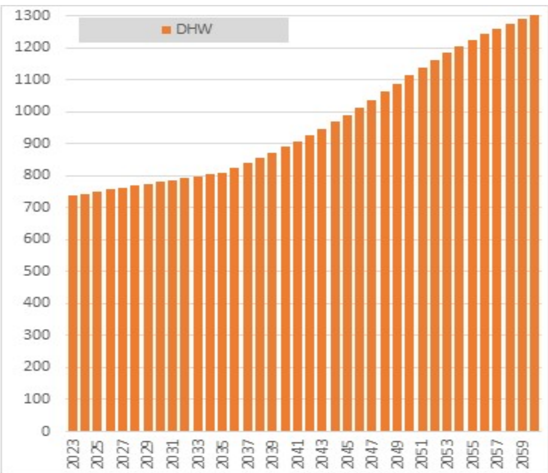


Figure I-24: Residential Final Energy Space Cooling forecast for BL Scenario, in GWh
Source: Calculated by the Consultant

Figure I-25: Residential Useful Space Cooling forecast for BL Scenario, in GWh
Source: Calculated by the Consultant



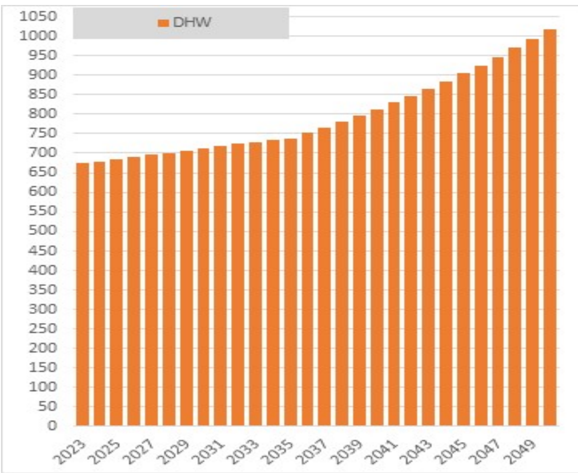


Figure I-26: Residential Final Energy Water Heating forecast for BL Scenario, in GWh
Source: Calculated by the Consultant

Figure I-27: Residential Useful Water Heating forecast for BL Scenario, in GWh
Source: Calculated by the Consultant

I.2.2 Public Municipal and Central Public Buildings Service Sub-Sector

The Services Sector is divided into two subsectors according to EUROSTAT and INSTAT: 1) Public Services and 2) Private Services, as shown in Figure I-28. Energy consumption in the Services Sector is influenced by various factors, including the number of buildings, their total area, the number of users, climatic zones, the technologies employed, their efficiencies, energy commodities used and the specific energy consumption associated with each energy service.

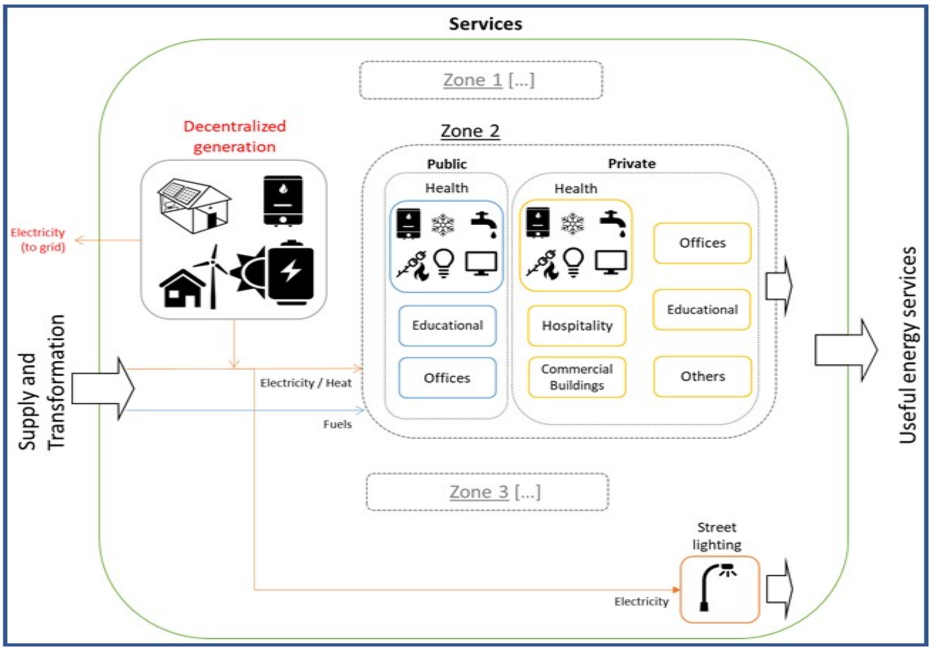


Figure I-28: Schematic presentation of all the public and private building categories that participate in the determination of energy consumption for services sector
Source: Prepared by the Consultant

The Public Services sub-sector primarily covers health, education, culture, and administration. In Albania, it is further categorized based on ownership: central public buildings and municipal public buildings. Historically, the heating demands and systems in the Public Services sector have been characterized by almost not thermal insulated buildings and moderate efficiencies in technical systems, installations, and operations. However, in recent years, more efficient technical systems have been introduced in some cases. The data on energy consumption for each service and the contributions of each energy source are based on various surveys conducted as part of the preparation of the Energy Strategy, detail analysis of five referent public buildings under the LTBRAP, as well as a detailed study carried out by MIE with the support of World Bank (WB). It is important to note that, in general, heating, cooking, hot water, and lighting systems across these sub-sectors have been applied with relatively low standards, often failing to meet comfort conditions. This is primarily due to outdated or mid-aged energy infrastructure and limited budgets, especially for municipal public buildings. Figures I-29 - I-30 shows the total final energy consumption of the public building stock for the years 2015 – 2023 (based on the yearly Energy Balances and above-mentioned assumptions).

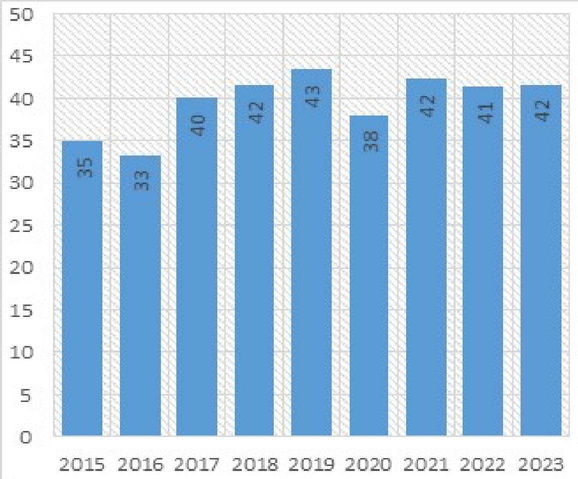


Figure I-29: Trend of final energy consumption for Public Buildings for the years 2015-2023 (ktoe)

Source: Calculations made by the Consultant based on Energy Balances 2015-2023, INSTAT, MIE/AKBN and WB

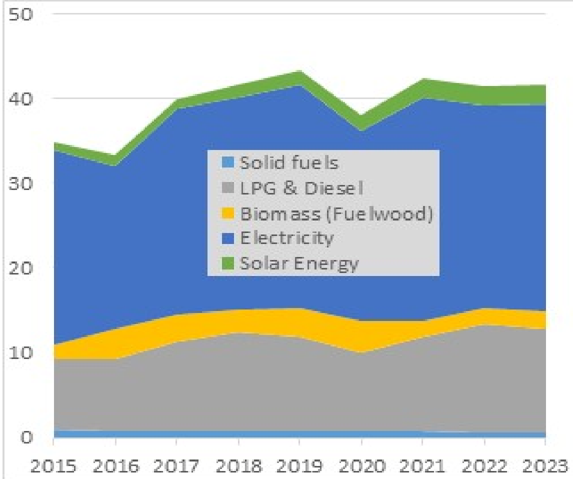


Figure I-30: Trend of final energy consumption for Public Buildings 2015-'23 (ktoe)

Source: Calculations made by the Consultant based on the Energy Balance 2015-2023, INSTAT, MIE/AKBN and WB

The analysis of the graphs reveals a slight decrease in energy consumption in the public buildings sub-sector during 2022 and 2023 compared to 2021. This reduction is attributed to various projects implemented by central and local governments, which have focused on improving the energy efficiency of their building stock. The analysis further shows that electricity is the primary energy source used, followed by LPG and diesel, with biomass (mainly in the form of fuel wood) being the next contributor. It is also important to note that solar energy, particularly through Solar Hot Water Systems and, more recently, PV Autoproducer systems, has been steadily increasing its contribution to meeting both hot water and electricity demands. This trend is expected to lay a solid foundation for greater market penetration in the coming years.

The electricity demand for public buildings was forecasted to cover part of space heating, water heating and cooking as well as fully the following three other services: lighting, space cooling and electrical equipment by carrying out calculation based on the following five steps below:

Step 1: The analysis of the public building stock for all municipalities and central public institutions shows the following overview based on the age of the buildings, according to the year of construction based on data presented under the LTBRAP:

- One quarter of the public building stock is older than 50 years;
- About 50% of the buildings were constructed during the period 1966 to 1988 according to the construction norms at that time and appropriate quality from thermal point of view from this period;
- 10% of the public buildings have been constructed between 1988 to 2009, usually at a low quality.
- 15% of the public buildings are constructed/renovated with moderate/high efficiency between 2010 to 2023;

About 15% of the buildings are relatively new with construction after 2009. Quality of construction of building structures is good in general, since thermal insultation of the outside walls, roofs and better performance windows have been applied. Performance of heating devices varies, for example: no use of condensing boilers, low share of heat pump mode at AC units and wood pellet boilers of medium/high efficiency. Application of solar collectors for SHW as well as lately PV Autoproducers in kindergartens and some heath facilities was increasing, due to increasing awareness, availability technologies and efforts by international donor projects and state budget secured by MIE and implemented by the Energy Efficiency Agency. Public Building Stock Forecast was carried out based Long Term Building Renovation Action Plan (LTBRAP-approved on February 2025). Conditional area of public buildings will be used as the driving factor for calculation of energy demand in general and electricity demand for each public building category for each climatic zone of Albania. Energy consumption in the public buildings is depended on several factors:

- Number of public buildings;
- Average area of public building according to the category;
- Distribution of public buildings per each climatic zone 1, 2, 3, of different type of public buildings: i) Municipal: Elementary & Other schools, kindergarten and daily care; ii) Municipal:

All Other Administrative Buildings; iii) Central: Universities & Dormitories; iv) Central: All Health and Social Buildings; and Central: v) All Administrative Buildings of All Ministries & Agencies.

The following sections is providing the analysis of these parameters and their breakdown in three climatic zones: 1, 2, and 3 for public buildings. The calculations have been made based on the concept of Heating Degree Days (HDD), taking into consideration all type of public buildings and six energy services (purposes) covering the basic energy services: space heating, space cooling, water heating, lighting, cooking and electric equipment.

Step 2: Public Building Stock Forecast is based on LTBRAP for the period 2023-2050 and extrapolated with lower growth rate by the consultant for the period 2051-2060. Results for the whole public building stock for each building category are presented at the figures I-31 - I-34.

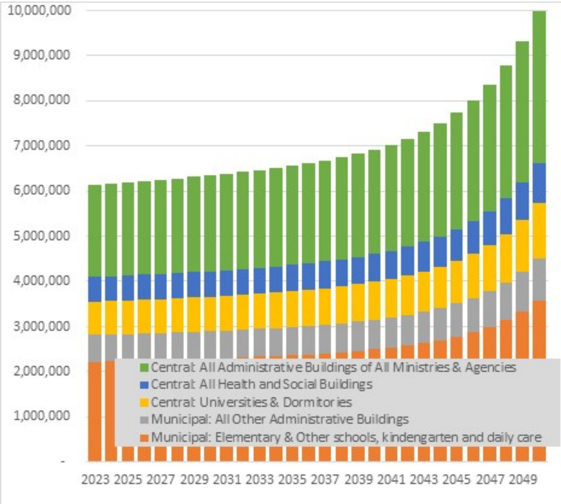


Figure I-31: Total forecasted floor area (m^2) of Public Building Stock for the whole Albania according to the different categories

Source: Calculations performed by the Consultant

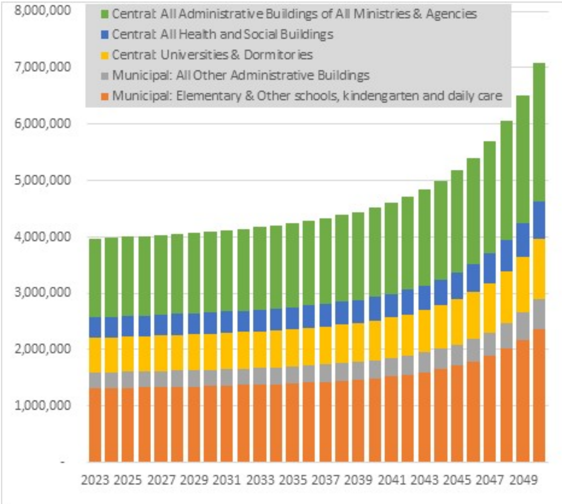


Figure I-32: Forecasted floor area (m^2) of Public Building Stock for Zone 1 according to the different categories

Source: Calculations performed by the Consultant

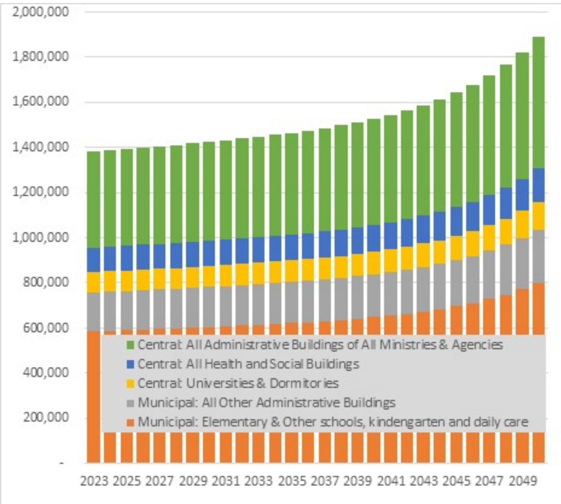


Figure I-33: Forecasted floor area (m^2) of Public Building Stock for Zone 2 according to the different categories

Source: Calculations performed by the Consultant

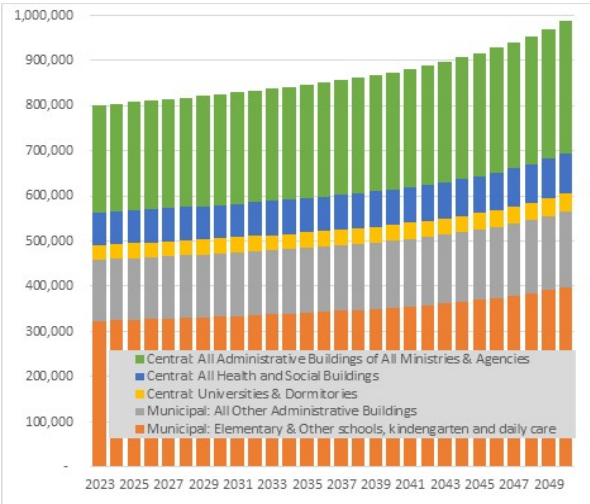


Figure I-34: Forecasted floor area (m^2) of Public Building Stock for Zone 1 according to the different categories

Source: Calculations performed by the Consultant

Step 3: Shares of Energy Commodities for each public building sub-category under each climatic zone for 2023 are based on the figures of the Yearly Energy Balance and are calculated by the consultant and expressed in %. Forecasted of share of the energy commodities, for each residential building sub-category under each climatic zone, for three scenarios: baseline scenario, NECP/WEM and NECP/WAM are based on the assumptions undertaken under the Strategy of Energy, LTBRAP and revised document of NECP. All respective figures and assumptions are presented at Table I-14.

Table I-14: Breakdown of total public buildings energy commodities on building categories for each climatic zone

Energy Commodities (EC)	Values of EC for 2023, GWh	Shares of EC for 2023, %	Forecasted of EC for BLS for 2050, %	Values of EC for 2023, GWh	Shares of EC for 2023, %	Forecasted of EC for BLS for 2050, %
Zone 1: Municipal: Elementary & Other schools, kindergarten and daily care				**Zone 1: Municipal: All Other Administrative Buildings**		
Solid fuels	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Natural Gas	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Oil by Products	41.13	44.17%	53.33%	5.81	44.21%	53.37%
Fuelwood	9.33	10.02%	12.09%	1.31	9.99%	12.06%
Electricity	37.72	40.51%	28.19%	4.92	37.40%	24.43%
Solar Energy	4.93	5.30%	6.39%	1.10	8.40%	10.14%
Derived Heat	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Zone 1: Central: Universities & Dormitories				**Zone 1: Central: All Health and Social Buildings**		
Solid fuels	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Natural Gas	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Oil by Products	14.05	44.18%	53.34%	18.52	44.95%	54.26%
Fuelwood	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Electricity	16.02	50.40%	40.12%	18.05	43.79%	32.14%
Solar Energy	1.72	5.41%	6.54%	4.64	11.26%	13.59%
Derived Heat	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Zone 1: Central: All Administrative Buildings of All Ministries & Agencies				**Zone 2: Municipal: Elementary & Other schools, kindergarten and daily care**		
Solid fuels	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Natural Gas	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Oil by Products	33.88	44.17%	53.33%	8.74	15.38%	18.57%
Fuelwood	0.00	0.00%	0.00%	5.70	10.02%	12.10%
Electricity	39.10	50.98%	40.82%	40.20	70.72%	64.66%
Solar Energy	3.72	4.85%	5.86%	2.20	3.87%	4.67%
Derived Heat	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Zone 2: *Municipal: All Other Administrative Buildings*				**Zone 2: *Central: Universities & Dormitories***		
Solid fuels	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Natural Gas	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Oil by Products	1.69	25.94%	31.31%	0.98	15.38%	18.57%
Fuelwood	1.09	16.82%	20.30%	0.00	0.00%	0.00%
Electricity	2.99	45.97%	34.78%	4.29	67.58%	60.86%
Solar Energy	0.73	11.27%	13.61%	1.08	17.03%	20.56%
Derived Heat	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Zone 2: *Central: All Health and Social Buildings*				**Zone 2: *All Administrative Buildings of All Ministries & Agencies***		
Solid fuels	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Natural Gas	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Oil by Products	2.58	15.43%	18.62%	5.49	15.41%	18.60%
Fuelwood	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Electricity	11.44	68.38%	61.83%	29.20	81.98%	78.24%
Solar Energy	2.71	16.19%	19.55%	0.93	2.61%	3.15%
Derived Heat	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Zone 3: *Municipal: Elementary & Other schools, kindergarten and daily care*				**Zone 3: *Municipal: All Other Administrative Buildings***		
Solid fuels	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Natural Gas	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Oil by Products	4.12	8.74%	10.55%	1.06	9.58%	11.56%
Fuelwood	5.50	11.67%	14.09%	1.29	11.68%	14.11%
Electricity	36.76	78.01%	73.45%	8.51	77.05%	72.30%
Solar Energy	0.74	1.58%	1.91%	0.19	1.68%	2.03%
Derived Heat	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Zone 3: *Central: Universities & Dormitories*				**Zone 3: *Central: All Health and Social Buildings***		
Solid fuels	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Natural Gas	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Oil by Products	0.34	9.80%	11.83%	1.40	8.36%	10.10%
Fuelwood	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Electricity	2.78	80.74%	76.75%	14.48	86.76%	84.02%
Solar Energy	0.33	9.46%	11.42%	0.81	4.88%	5.89%
Derived Heat	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Zone 3: *All Administrative Buildings of All Ministries & Agencies*						
Solid fuels	0.00	0.00%	0.00%			

Natural Gas	0.00	0.00%	0.00%	
Oil by Products	2.66	8.89%	10.74%	
Fuelwood	0.00	0.00%	0.00%	
Electricity	26.84	89.63%	87.48%	
Solar Energy	0.44	1.48%	1.78%	

Source: Calculated by the Consultant

Step 4: Breakdown of energy commodities for each of the public buildings building sub-categories under each climatic zone on the respective energy services: 1) Space Heating; 2) Domestic Hot Water (DHW); 3) Space Cooling; 4) Cooking; 5) Lighting; and 6) Electrical Appliances are presented for each scenario at the Table I-15 Forecasted of share of the energy services, for each public building sub-category under each climatic zone, for three scenarios: baseline scenario, NECP/WEM and NECP/WAM are based on the calculations of each respective referent public buildings undertaken under the LTBRAP.

Table I-15: Actual and forecast shares for each energy service, for residential building categories for each zone, for three scenarios

Energy Services (ES)	Values of ES for 2023, GWh	Shares of ES for 2023, %	Forecasted of ES for BLS for 2050, %	Values of ES for 2023, GWh	Shares of ES for 2023, %	Forecasted of ES for BLS for 2050, %
Zone 1: Municipal: Elementary & Other schools, kindergarten and daily care			**Zone 1: Municipal: All Other Administrative Buildings**			
Space Heating	60.34	64.81%	59.76%	6.20	47.15%	43.48%
DHW	9.06	9.73%	10.27%	0.79	6.01%	6.34%
Cooling	13.50	14.50%	19.86%	1.71	13.02%	19.00%
Cooking	3.95	4.25%	3.92%	0.98	7.42%	6.85%
Lighting	3.53	3.79%	3.50%	1.76	13.41%	12.37%
El. Appliances	2.72	2.92%	2.69%	1.71	12.98%	11.97%
Zone 1: Central: Universities & Dormitories			**Zone 1: Central: All Health and Social Buildings**			
Space Heating	12.56	39.51%	36.44%	17.17	41.67%	38.43%
DHW	6.66	20.94%	22.10%	6.20	15.04%	15.87%
Cooling	2.92	9.20%	13.48%	4.05	9.83%	14.85%
Cooking	1.33	4.19%	3.86%	5.27	12.78%	11.79%
Lighting	4.32	13.59%	12.53%	3.87	9.39%	8.66%
El. Appliances	3.99	12.56%	11.59%	4.65	11.28%	10.40%
Zone 1: Central: All Administrative Buildings of All Ministries & Agencies			**Zone 2: Municipal: Elementary & Other schools, kindergarten and daily care**			
Space Heating	34.72	45.26%	41.74%	40.60	71.44%	65.87%
DHW	7.42	9.68%	10.21%	5.23	9.21%	9.72%
Cooling	8.11	10.57%	16.25%	5.00	8.79%	14.67%
Cooking	1.86	2.42%	2.23%	2.39	4.21%	3.88%
Lighting	10.67	13.92%	12.83%	2.04	3.59%	3.31%
El. Appliances	13.92	18.15%	16.73%	1.57	2.76%	2.55%
Zone 2: Municipal: All Other Administrative Buildings			**Zone 2: Central: Universities & Dormitories**			
Space Heating	3.08	48.44%	52.44%	3.08	48.44%	44.67%
DHW	1.18	18.52%	5.29%	1.18	18.52%	19.55%
Cooling	0.39	6.20%	14.76%	0.39	6.20%	11.04%
Cooking	0.24	3.70%	5.71%	0.24	3.70%	3.42%
Lighting	0.76	12.02%	10.32%	0.76	12.02%	11.08%
El. Appliances	0.71	11.11%	11.47%	0.71	11.11%	10.25%
Zone 2: Central: All Health and Social Buildings			**Zone 2: All Administrative Buildings of All Ministries & Agencies**			
Space Heating	8.54	51.02%	47.04%	19.51	54.78%	50.51%
DHW	2.19	13.10%	13.83%	2.97	8.33%	8.79%
Cooling	1.11	6.62%	12.15%	2.51	7.04%	13.17%
Cooking	1.86	11.14%	10.27%	0.74	2.08%	1.92%
Lighting	1.39	8.30%	7.65%	4.33	12.15%	11.21%
El. Appliances	1.64	9.83%	9.06%	5.56	15.62%	14.40%
Zone 3: Municipal: Elementary & Other schools, kindergarten and daily care			**Zone 3: Municipal: All Other Administrative Buildings**			
Space Heating	37.11	78.76%	72.63%	7.77	70.31%	64.83%
DHW	2.88	6.11%	6.44%	0.41	3.67%	3.88%
Cooling	1.94	4.11%	10.77%	0.42	3.77%	10.77%
Cooking	1.38	2.93%	2.70%	0.51	4.64%	4.28%
Lighting	2.95	6.26%	5.77%	0.94	8.49%	7.83%
El. Appliances	0.86	1.83%	1.69%	1.01	9.12%	8.41%
Zone 3: Central: Universities & Dormitories			**Zone 3: Central: All Health and Social Buildings**			
Space Heating	2.11	61.43%	56.65%	10.63	63.72%	58.75%
DHW	0.50	14.39%	15.19%	1.70	10.20%	10.77%
Cooling	0.10	2.99%	8.63%	0.53	3.15%	9.34%
Cooking	0.10	2.88%	2.65%	1.45	8.67%	8.00%
Lighting	0.33	9.67%	8.92%	1.10	6.60%	6.09%
El. Appliances	0.30	8.64%	7.96%	1.28	7.65%	7.06%
Zone 3: All Administrative Buildings of All Ministries & Agencies						
Space Heating	20.16	67.32%	62.07%			
DHW	1.91	6.37%	6.72%			
Cooling	0.99	3.29%	9.98%			
Cooking	0.48	1.59%	1.47%			
Lighting	2.84	9.49%	8.75%			
El. Appliances	3.58	11.94%	11.01%			

Source: Calculated by the Consultant

Step 5: Forecast of energy demand for all public buildings categories up to 2050 is calculated based on the energy intensities for all energy commodities according to the energy strategy for the period 2023-2050 for each referent building under each climatic zone (Table I-16).

Table I-16: Actual and forecasted energy intensity values on public building sector (kWh/m2)

Public buildings sub-sector	2023	2030	2035	2040	2045	2050
ZONE 1	64.59	62.91	61.72	60.52	59.33	58.15
Municipal: Elementary & Other schools, kindergarten and daily care	71.05	69.21	67.89	66.57	65.26	63.94
Municipal: All Other Administrative Buildings	46.52	45.32	44.46	43.59	42.73	41.87
Central: Universities & Dormitories	51.67	50.33	49.37	48.42	47.46	46.50
Central: All Health and Social Buildings	113.04	110.10	108.01	105.92	103.83	101.73
All Administrative Buildings of All Ministries & Agencies	55.19	53.76	52.74	51.72	50.69	49.67
ZONE 2	88.35	86.06	84.42	82.79	81.15	79.51
Municipal: Elementary & Other schools, kindergarten and daily care	97.03	94.52	92.72	90.93	89.13	87.33
Municipal: All Other Administrative Buildings	37.76	36.78	36.08	35.38	34.68	33.98
Central: Universities & Dormitories	70.60	68.77	67.46	66.16	64.85	63.54
Central: All Health and Social Buildings	154.35	150.35	147.49	144.63	141.78	138.92
All Administrative Buildings of All Ministries & Agencies	83.80	81.62	80.07	78.52	76.97	75.42
ZONE 3	135.19	131.69	129.18	126.68	124.18	121.67
Municipal: Elementary & Other schools, kindergarten and daily care	145.89	142.10	139.40	136.70	134.00	131.30
Municipal: All Other Administrative Buildings	81.48	79.37	77.86	76.35	74.84	73.33
Central: Universities & Dormitories	105.97	103.22	101.26	99.30	97.33	95.37
Central: All Health and Social Buildings	232.17	226.15	221.85	217.55	213.26	208.96
All Administrative Buildings of All Ministries & Agencies	125.99	122.73	120.39	118.06	115.73	113.39
TOTAL	**79.13**	**77.05**	**75.51**	**73.79**	**71.65**	**68.50**

Source: Calculated by the Consultant

Step 6: Carry out the Final Energy Demand Forecast, for each energy commodity, for each public building subcategory and for each climatic zone based on the formula:

EnergyComm.$_{demand}$ = activity level x share of energy commodity x energy intensity for each public building subcategory and for each climatic zone.

Calculation of final energy demand was carried out based on the entire data mentioned on all steps above for each building sub-category, each energy service and the respective values are presented at the Table I-17.

Table I-17: Forecast final energy demand (GWh/year), for public buildings category, under each climatic zone and for each scenario

Public Buildings sub-sector	2023	2030	2035	2040	2045	2050
ZONE 1						
Municipal: Elementary & Other schools, kindergarten and daily care						
Solid fuels	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00
Oil by Products	41.13	43.42	45.63	49.36	57.52	80.58
Fuelwood	9.33	9.84	10.35	11.19	13.04	18.27
Electricity	37.72	35.14	33.56	32.77	34.23	42.59
Solar Energy	4.93	5.20	5.47	5.92	6.89	9.66
Derived Heat	0.00	0.00	0.00	0.00	0.00	0.00
Municipal: All Other Administrative Buildings						
Solid fuels	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00
Oil by Products	5.81	6.13	6.45	7.01	8.29	12.03
Fuelwood	1.31	1.39	1.46	1.58	1.87	2.72
Electricity	4.92	4.53	4.29	4.16	4.34	5.50
Solar Energy	1.10	1.17	1.23	1.33	1.57	2.29
Derived Heat	0.00	0.00	0.00	0.00	0.00	0.00
Central: Universities & Dormitories						
Solid fuels	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00
Oil by Products	14.05	14.87	15.65	16.90	19.49	26.44
Fuelwood	0.00	0.00	0.00	0.00	0.00	0.00
Electricity	16.02	15.36	15.01	15.01	15.96	19.89
Solar Energy	1.72	1.82	1.92	2.07	2.39	3.24
Derived Heat	0.00	0.00	0.00	0.00	0.00	0.00
Central: All Health and Social Buildings						
Solid fuels	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00
Oil by Products	18.52	19.59	20.62	22.32	25.96	36.05
Fuelwood	0.00	0.00	0.00	0.00	0.00	0.00
Electricity	18.05	17.01	16.40	16.19	17.07	21.35

Solar Energy	4.64	4.91	5.16	5.59	6.50	9.03
Derived Heat	0.00	0.00	0.00	0.00	0.00	0.00
All Administrative Buildings of All Ministries & Agencies						
Solid fuels	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00
Oil by Products	33.88	35.83	37.69	40.76	47.31	65.45
Fuelwood	0.00	0.00	0.00	0.00	0.00	0.00
Electricity	39.10	37.48	36.65	36.72	39.36	50.10
Solar Energy	3.72	3.93	4.14	4.48	5.20	7.19
Derived Heat	0.00	0.00	0.00	0.00	0.00	0.00
ZONE 2						
Municipal: Elementary & Other schools, kindergarten and daily care						
Solid fuels	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00
Oil by Products	8.74	9.22	9.63	10.20	11.13	13.00
Fuelwood	5.70	6.01	6.28	6.64	7.25	8.47
Electricity	40.20	39.53	39.25	39.46	40.86	45.24
Solar Energy	2.20	2.32	2.42	2.56	2.80	3.27
Derived Heat	0.00	0.00	0.00	0.00	0.00	0.00
Municipal: All Other Administrative Buildings						
Solid fuels	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00
Oil by Products	1.69	1.78	1.86	1.97	2.15	2.51
Fuelwood	1.09	1.15	1.20	1.27	1.39	1.62
Electricity	2.99	2.82	2.72	2.64	2.63	2.78
Solar Energy	0.73	0.77	0.81	0.85	0.93	1.09
Derived Heat	0.00	0.00	0.00	0.00	0.00	0.00
Central: Universities & Dormitories						
Solid fuels	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00
Oil by Products	0.98	1.03	1.08	1.14	1.24	1.45
Fuelwood	0.00	0.00	0.00	0.00	0.00	0.00
Electricity	4.29	4.21	4.16	4.18	4.31	4.76
Solar Energy	1.08	1.14	1.19	1.26	1.38	1.61
Derived Heat	0.00	0.00	0.00	0.00	0.00	0.00
Central: All Health and Social Buildings						
Solid fuels	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00
Oil by Products	2.58	2.72	2.84	3.01	3.28	3.83
Fuelwood	0.00	0.00	0.00	0.00	0.00	0.00
Electricity	11.44	11.22	11.11	11.15	11.52	12.73
Solar Energy	2.71	2.85	2.98	3.16	3.44	4.02
Derived Heat	0.00	0.00	0.00	0.00	0.00	0.00
Central: All Administrative Buildings of All Ministries & Agencies						
Solid fuels	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00
Oil by Products	5.49	5.79	6.04	6.40	6.98	8.15
Fuelwood	0.00	0.00	0.00	0.00	0.00	0.00
Electricity	29.20	28.99	29.00	29.39	30.69	34.29
Solar Energy	0.93	0.98	1.02	1.08	1.18	1.38
Derived Heat	0.00	0.00	0.00	0.00	0.00	0.00
ZONE 3						
Municipal: Elementary & Other schools, kindergarten and daily care						
Solid fuels	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00
Oil by Products	4.12	4.34	4.52	4.74	5.04	5.52
Fuelwood	5.50	5.80	6.04	6.33	6.74	7.37
Electricity	36.76	36.37	36.19	36.25	36.82	38.42
Solar Energy	0.74	0.78	0.82	0.86	0.91	1.00
Derived Heat	0.00	0.00	0.00	0.00	0.00	0.00
Municipal: All Other Administrative Buildings						
Solid fuels	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00
Oil by Products	1.06	1.12	1.16	1.22	1.30	1.42
Fuelwood	1.29	1.36	1.42	1.49	1.58	1.73
Electricity	8.51	8.42	8.38	8.39	8.51	8.88
Solar Energy	0.19	0.20	0.20	0.21	0.23	0.25
Derived Heat	0.00	0.00	0.00	0.00	0.00	0.00
Central: Universities & Dormitories						

Solid fuels	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00
Oil by Products	0.34	0.36	0.37	0.39	0.41	0.45
Fuelwood	0.00	0.00	0.00	0.00	0.00	0.00
Electricity	2.78	2.76	2.75	2.76	2.80	2.93
Solar Energy	0.33	0.34	0.36	0.37	0.40	0.44
Derived Heat	0.00	0.00	0.00	0.00	0.00	0.00
Central: All Health and Social Buildings						
Solid fuels	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00
Oil by Products	1.40	1.47	1.53	1.61	1.71	1.87
Fuelwood	0.00	0.00	0.00	0.00	0.00	0.00
Electricity	14.48	14.42	14.42	14.52	14.83	15.56
Solar Energy	0.81	0.86	0.89	0.94	1.00	1.09
Derived Heat	0.00	0.00	0.00	0.00	0.00	0.00
All Administrative Buildings of All Ministries & Agencies						
Solid fuels	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00
Oil by Products	2.66	2.81	2.92	3.07	3.26	3.57
Fuelwood	0.00	0.00	0.00	0.00	0.00	0.00
Electricity	26.84	26.79	26.83	27.05	27.67	29.09
Solar Energy	0.44	0.47	0.49	0.51	0.54	0.59
Derived Heat	0.00	0.00	0.00	0.00	0.00	0.00

Source: Calculated by the Consultant

Step 7: Carry out the Final Energy Demand Forecast for each energy service category: 1) Space Heating; 2) Domestic Hot Water (DHW); 3) Space Cooling; 4) Cooking; 5) Lighting; and 6) Electrical Appliances for each public buildings subcategory and for each climatic zone based on the formula:

> $EnergyService._{demand}$ = activity level x share of energy service x energy intensity for each public building subcategory and for each climatic zone.

Calculation of final energy service demand was carried out based on the entire data mentioned on all steps above for each building sub-category, for each energy service and the respective values are presented at the Table I-18.

Table I-18: Forecast final energy demand (GWh/year), for each energy service, for each public buildings categories, under each climatic zone and for baseline scenario

Public Buildings sub-sector	2023	2030	2035	2040	2045	2050
ZONE 1						
Municipal: Elementary & Other schools, kindergarten and daily care						
Space Heating	60.34	59.40	59.39	61.11	67.75	90.30
DHW	9.06	9.24	9.47	9.99	11.36	15.53
Cooling	13.50	14.92	16.10	17.80	21.12	30.01
Cooking	3.95	3.89	3.89	4.01	4.44	5.92
Lighting	3.53	3.48	3.48	3.58	3.96	5.28
El. Appliances	2.72	2.68	2.68	2.75	3.05	4.07
Municipal: All Other Administrative Buildings						
Space Heating	6.20	6.10	6.10	6.31	7.10	9.80
DHW	0.79	0.80	0.83	0.88	1.01	1.43
Cooling	1.71	1.93	2.11	2.37	2.88	4.28
Cooking	0.98	0.96	0.96	0.99	1.12	1.54
Lighting	1.76	1.73	1.74	1.79	2.02	2.79
El. Appliances	1.71	1.68	1.68	1.74	1.95	2.70
Central: Universities & Dormitories						
Space Heating	12.56	12.40	12.42	12.76	14.00	18.06
DHW	6.66	6.81	6.99	7.36	8.28	10.95
Cooling	2.92	3.32	3.64	4.06	4.82	6.68
Cooking	1.33	1.31	1.32	1.35	1.48	1.91
Lighting	4.32	4.27	4.27	4.39	4.81	6.21
El. Appliances	3.99	3.94	3.95	4.06	4.45	5.74
Central: All Health and Social Buildings						
Space Heating	17.17	16.94	16.96	17.46	19.32	25.53
DHW	6.20	6.33	6.50	6.86	7.78	10.55
Cooling	4.05	4.64	5.11	5.75	6.91	9.86
Cooking	5.27	5.20	5.20	5.36	5.93	7.83
Lighting	3.87	3.82	3.82	3.93	4.35	5.75

El. Appliances	4.65	4.59	4.59	4.73	5.23	6.91
All Administrative Buildings of All Ministries & Agencies						
Space Heating	34.72	34.24	34.26	35.25	38.93	51.23
DHW	7.42	7.58	7.78	8.21	9.29	12.54
Cooling	8.11	9.35	10.33	11.65	14.00	19.95
Cooking	1.86	1.83	1.83	1.88	2.08	2.74
Lighting	10.67	10.53	10.53	10.84	11.97	15.75
El. Appliances	13.92	13.73	13.74	14.13	15.61	20.54
ZONE 2						
Municipal: Elementary & Other schools, kindergarten and daily care						
Space Heating	40.60	39.92	39.67	39.96	41.48	46.09
DHW	5.23	5.33	5.43	5.61	5.97	6.80
Cooling	5.00	5.92	6.61	7.39	8.45	10.27
Cooking	2.39	2.35	2.34	2.35	2.44	2.72
Lighting	2.04	2.00	1.99	2.01	2.08	2.31
El. Appliances	1.57	1.54	1.53	1.55	1.60	1.78
Municipal: All Other Administrative Buildings						
Space Heating	3.70	3.63	3.61	3.64	3.78	4.20
DHW	0.33	0.33	0.34	0.35	0.37	0.42
Cooling	0.54	0.65	0.74	0.84	0.97	1.18
Cooking	0.40	0.40	0.39	0.40	0.41	0.46
Lighting	0.73	0.72	0.71	0.72	0.74	0.83
El. Appliances	0.81	0.79	0.79	0.80	0.83	0.92
Central: Universities & Dormitories						
Space Heating	3.08	3.02	3.00	3.03	3.14	3.49
DHW	1.18	1.20	1.22	1.26	1.34	1.53
Cooling	0.39	0.48	0.54	0.61	0.71	0.86
Cooking	0.24	0.23	0.23	0.23	0.24	0.27
Lighting	0.76	0.75	0.75	0.75	0.78	0.87
El. Appliances	0.71	0.69	0.69	0.69	0.72	0.80
Central: All Health and Social Buildings						
Space Heating	8.54	8.39	8.33	8.39	8.71	9.68
DHW	2.19	2.23	2.27	2.35	2.50	2.85
Cooling	1.11	1.36	1.55	1.76	2.04	2.50
Cooking	1.86	1.83	1.82	1.83	1.90	2.11
Lighting	1.39	1.36	1.36	1.37	1.42	1.58
El. Appliances	1.64	1.62	1.61	1.62	1.68	1.87
All Administrative Buildings of All Ministries & Agencies						
Space Heating	19.51	19.18	19.06	19.19	19.92	22.14
DHW	2.97	3.02	3.08	3.18	3.38	3.85
Cooling	2.51	3.10	3.55	4.04	4.69	5.77
Cooking	0.74	0.73	0.72	0.73	0.76	0.84
Lighting	4.33	4.25	4.23	4.26	4.42	4.91
El. Appliances	5.56	5.47	5.43	5.47	5.68	6.31
ZONE 3						
Municipal: Elementary & Other schools, kindergarten and daily care						
Space Heating	37.11	36.47	36.13	36.06	36.50	37.99
DHW	2.88	2.93	2.97	3.04	3.16	3.37
Cooling	1.94	2.79	3.40	4.03	4.74	5.63
Cooking	1.38	1.36	1.34	1.34	1.36	1.41
Lighting	2.95	2.90	2.87	2.86	2.90	3.02
El. Appliances	0.86	0.85	0.84	0.84	0.85	0.88
Municipal: All Other Administrative Buildings						
Space Heating	7.77	7.64	7.57	7.55	7.65	7.96
DHW	0.41	0.41	0.42	0.43	0.45	0.48
Cooling	0.42	0.63	0.78	0.93	1.11	1.32
Cooking	0.51	0.50	0.50	0.50	0.50	0.52
Lighting	0.94	0.92	0.91	0.91	0.92	0.96
El. Appliances	1.01	0.99	0.98	0.98	0.99	1.03
Central: Universities & Dormitories						
Space Heating	2.11	2.08	2.06	2.05	2.08	2.16
DHW	0.50	0.50	0.51	0.52	0.54	0.58
Cooling	0.10	0.16	0.19	0.23	0.28	0.33
Cooking	0.10	0.10	0.10	0.10	0.10	0.10
Lighting	0.33	0.33	0.32	0.32	0.33	0.34
El. Appliances	0.30	0.29	0.29	0.29	0.29	0.30
Central: All Health and Social Buildings						
Space Heating	10.63	10.45	10.35	10.33	10.46	10.88
DHW	1.70	1.73	1.76	1.80	1.87	2.00

Cooling	0.53	0.81	1.01	1.21	1.44	1.73
Cooking	1.45	1.42	1.41	1.41	1.42	1.48
Lighting	1.10	1.08	1.07	1.07	1.08	1.13
El. Appliances	1.28	1.25	1.24	1.24	1.26	1.31
All Administrative Buildings of All Ministries & Agencies						
Space Heating	20.16	19.81	19.63	19.59	19.83	20.64
DHW	1.91	1.94	1.97	2.02	2.10	2.24
Cooling	0.99	1.53	1.92	2.32	2.76	3.32
Cooking	0.48	0.47	0.46	0.46	0.47	0.49
Lighting	2.84	2.79	2.77	2.76	2.79	2.91
El. Appliances	3.58	3.52	3.48	3.48	3.52	3.66

Source: Calculated by the Consultant

Step 8: Useful energy for each energy service category: 1) Space Heating; 2) Domestic Hot Water (DHW); 3) Space Cooling; 4) Cooking; 5) Lighting; and 6) Electrical Appliances for each public building subcategory is calculated based on final energy (calculated under step 7) multiplied with average efficiencies for group of technical systems (table I-19), used under each building category, under each climatic zone. Average efficiencies for technical systems assumed are based on energy surveys carried out for the public building sub-sector by the AEE and figures used under National Strategy of Energy and NECP.

Table I-19: Average efficiencies for technical systems, for public buildings category, under each climatic zone and for each scenario

Buildings Categories	Average Space Heating Efficiency Technical Systems:							Average Water Heating Eff. Tech. Systems	Average Water Heating Eff. Tech. Systems Cooling	Average Cooking Eff. Tech. Systems	Average Lighting Eff. Tech. Systems	Average Elec. Appl. Eff. Tech. Systems
	Elect. AC split unit	Elect. Heat.	Diesel	LPG	Wood	Pell.	Aggreg. Effic.					
Zone 1												
Municipal: Elementary & Other schools, kindergarten and daily care	90%	100 %	80.0%	81.0%	48.0%	68.0%	80.2%	91.0%	90.0%	72.3%	94.5%	85.5%
Municipal: All Other Administrative Buildings	90%	100 %	80.0%	81.0%	48.0%	68.0%	80.7%	91.0%	90.0%	70.9%	94.5%	85.5%
Central: Universities & Dormitories	90%	100 %	80.0%	81.0%	48.0%	68.0%	83.7%	91.0%	90.0%	76.9%	94.5%	85.5%
Central: All Health and Social Buildings	90%	100 %	80.0%	81.0%	48.0%	68.0%	85.8%	91.0%	90.0%	73.9%	94.5%	85.5%
Central: All Administrative Buildings of All Ministries & Agencies	90%	100 %	80.0%	81.0%	48.0%	68.0%	81.9%	91.0%	90.0%	77.2%	94.5%	85.5%
Zone 2												
Municipal: Elementary & Other schools, kindergarten and daily care	88%	100 %	78.0%	79.0%	43.0%	63.0%	68.3%	88.8%	88.0%	80.1%	92.4%	83.6%
Municipal: All Other Administrative Buildings	88%	100 %	78.0%	79.0%	43.0%	63.0%	68.8%	88.8%	88.0%	69.4%	92.4%	83.6%
Central: Universities & Dormitories	88%	100 %	78.0%	79.0%	43.0%	63.0%	78.9%	88.8%	88.0%	78.6%	92.4%	83.6%
Central: All Health and Social Buildings	88%	100 %	78.0%	79.0%	43.0%	63.0%	75.2%	88.8%	88.0%	79.0%	92.4%	83.6%
Central: All Administrative Buildings of All Ministries & Agencies	88%	100 %	78.0%	79.0%	38.0%	60.0%	69.1%	88.4%	88.0%	85.5%	92.4%	83.6%
Zone 3												

Municipal: Elementary & Other schools, kindergarten and daily care	85%	100 %	75.0%	76.0%	38.0%	60.0%	79.8%	85.5%	85.0%	79.6%	89.3%	80.8%
Municipal: All Other Administrative Buildings	85%	100 %	75.0%	76.0%	38.0%	60.0%	71.9%	85.5%	85.0%	79.2%	89.3%	80.8%
Central: Universities & Dormitories	85%	100 %	75.0%	76.0%	38.0%	60.0%	70.6%	85.5%	85.0%	81.2%	89.3%	80.8%
Central: All Health and Social Buildings	85%	100 %	75.0%	76.0%	38.0%	60.0%	71.8%	85.5%	85.0%	84.1%	89.3%	80.8%
Central: All Administrative Buildings of All Ministries & Agencies	85%	100 %	75.0%	76.0%	38.0%	60.0%	78.0%	85.5%	85.0%	85.6%	89.3%	80.8%

Calculation of useful energy service demand was carried out, for each public building sub-category, for each climatic zone and the respective values are presented at the Table I-20.

Table I-20: Forecast useful energy demand (GWh/year), for each energy service, for each public buildings categories, under each climatic zone and for baseline scenario

Public Buildings sub-sector	2023	2030	2035	2040	2045	2050
ZONE 1						
Municipal: Elementary & Other schools, kindergarten and daily care						
Space Heating	48.36	47.61	47.60	48.98	54.30	72.38
DHW	8.25	8.41	8.62	9.10	10.34	14.13
Cooling	12.15	13.43	14.49	16.02	19.00	27.01
Cooking	2.86	2.82	2.82	2.90	3.21	4.28
Lighting	3.34	3.28	3.28	3.38	3.75	4.99
El. Appliances	2.32	2.29	2.29	2.35	2.61	3.48
Municipal: All Other Administrative Buildings						
Space Heating	5.00	4.92	4.92	5.09	5.73	7.91
DHW	0.72	0.73	0.75	0.80	0.92	1.30
Cooling	1.54	1.74	1.90	2.13	2.59	3.85
Cooking	0.69	0.68	0.68	0.70	0.79	1.09
Lighting	1.67	1.64	1.64	1.70	1.91	2.63
El. Appliances	1.46	1.44	1.44	1.48	1.67	2.31
Central: Universities & Dormitories						
Space Heating	10.51	10.38	10.39	10.68	11.71	15.11
DHW	6.06	6.19	6.36	6.70	7.54	9.97
Cooling	2.63	2.99	3.27	3.66	4.33	6.01
Cooking	1.02	1.01	1.01	1.04	1.14	1.47
Lighting	4.08	4.03	4.04	4.15	4.55	5.87
El. Appliances	3.42	3.37	3.38	3.47	3.81	4.91
Central: All Health and Social Buildings						
Space Heating	14.73	14.53	14.55	14.98	16.58	21.90
DHW	5.64	5.76	5.91	6.24	7.08	9.60
Cooling	3.64	4.18	4.60	5.18	6.22	8.88
Cooking	3.90	3.84	3.85	3.96	4.38	5.79
Lighting	3.66	3.61	3.61	3.72	4.11	5.44
El. Appliances	3.97	3.92	3.92	4.04	4.47	5.91
All Administrative Buildings of All Ministries & Agencies						
Space Heating	28.43	28.03	28.05	28.85	31.87	41.94
DHW	6.76	6.90	7.08	7.47	8.46	11.41
Cooling	7.30	8.41	9.30	10.48	12.60	17.95
Cooking	1.43	1.41	1.41	1.45	1.61	2.11
Lighting	10.09	9.95	9.95	10.24	11.31	14.88
El. Appliances	11.90	11.74	11.74	12.08	13.34	17.56
ZONE 2						
Municipal: Elementary & Other schools, kindergarten and daily care						
Space Heating	27.75	27.28	27.11	27.31	28.35	31.50
DHW	4.65	4.73	4.82	4.98	5.30	6.04
Cooling	4.40	5.21	5.81	6.51	7.44	9.03
Cooking	1.92	1.89	1.87	1.89	1.96	2.18
Lighting	1.88	1.85	1.84	1.85	1.92	2.14

El. Appliances	1.31	1.29	1.28	1.29	1.34	1.49
Municipal: All Other Administrative Buildings						
Space Heating	2.54	2.50	2.48	2.50	2.60	2.89
DHW	0.29	0.29	0.30	0.31	0.33	0.38
Cooling	0.47	0.58	0.65	0.74	0.85	1.04
Cooking	0.28	0.27	0.27	0.27	0.29	0.32
Lighting	0.67	0.66	0.66	0.66	0.69	0.76
El. Appliances	0.68	0.66	0.66	0.67	0.69	0.77
Central: Universities & Dormitories						
Space Heating	2.43	2.39	2.37	2.39	2.48	2.76
DHW	1.04	1.06	1.08	1.12	1.19	1.36
Cooling	0.35	0.42	0.48	0.54	0.62	0.76
Cooking	0.18	0.18	0.18	0.18	0.19	0.21
Lighting	0.71	0.69	0.69	0.69	0.72	0.80
El. Appliances	0.59	0.58	0.58	0.58	0.60	0.67
Central: All Health and Social Buildings						
Space Heating	6.42	6.31	6.27	6.32	6.56	7.29
DHW	1.95	1.98	2.02	2.09	2.22	2.53
Cooling	0.97	1.20	1.36	1.55	1.79	2.20
Cooking	1.47	1.45	1.44	1.45	1.50	1.67
Lighting	1.28	1.26	1.25	1.26	1.31	1.46
El. Appliances	1.37	1.35	1.34	1.35	1.40	1.56
All Administrative Buildings of All Ministries & Agencies						
Space Heating	13.49	13.26	13.18	13.27	13.78	15.31
DHW	2.62	2.67	2.72	2.81	2.99	3.41
Cooling	2.21	2.73	3.12	3.56	4.13	5.08
Cooking	0.63	0.62	0.62	0.62	0.65	0.72
Lighting	4.00	3.93	3.91	3.93	4.08	4.54
El. Appliances	4.65	4.57	4.54	4.58	4.75	5.28
ZONE 3						
Municipal: Elementary & Other schools, kindergarten and daily care						
Space Heating	29.62	29.11	28.84	28.78	29.14	30.32
DHW	2.46	2.50	2.54	2.60	2.70	2.88
Cooling	1.66	2.38	2.90	3.45	4.05	4.81
Cooking	1.10	1.08	1.07	1.07	1.08	1.13
Lighting	2.63	2.59	2.56	2.56	2.59	2.69
El. Appliances	0.70	0.68	0.68	0.68	0.69	0.71
Municipal: All Other Administrative Buildings						
Space Heating	5.58	5.49	5.44	5.43	5.50	5.72
DHW	0.35	0.35	0.36	0.37	0.38	0.41
Cooling	0.35	0.53	0.66	0.79	0.94	1.12
Cooking	0.41	0.40	0.40	0.39	0.40	0.42
Lighting	0.84	0.82	0.82	0.81	0.82	0.86
El. Appliances	0.81	0.80	0.79	0.79	0.80	0.83
Central: Universities & Dormitories						
Space Heating	1.49	1.47	1.45	1.45	1.47	1.53
DHW	0.42	0.43	0.44	0.45	0.46	0.50
Cooling	0.09	0.13	0.16	0.20	0.23	0.28
Cooking	0.08	0.08	0.08	0.08	0.08	0.08
Lighting	0.30	0.29	0.29	0.29	0.29	0.30
El. Appliances	0.24	0.24	0.23	0.23	0.24	0.25
Central: All Health and Social Buildings						
Space Heating	7.63	7.50	7.43	7.42	7.51	7.81
DHW	1.46	1.48	1.50	1.54	1.60	1.70
Cooling	0.45	0.68	0.86	1.03	1.23	1.47
Cooking	1.22	1.20	1.18	1.18	1.20	1.25
Lighting	0.98	0.97	0.96	0.96	0.97	1.01
El. Appliances	1.03	1.01	1.00	1.00	1.01	1.06
All Administrative Buildings of All Ministries & Agencies						
Space Heating	15.73	15.46	15.32	15.29	15.48	16.10
DHW	1.63	1.66	1.69	1.72	1.79	1.91
Cooling	0.84	1.30	1.63	1.97	2.35	2.82
Cooking	0.41	0.40	0.40	0.40	0.40	0.42
Lighting	2.53	2.49	2.47	2.46	2.49	2.60
El. Appliances	2.89	2.84	2.81	2.81	2.84	2.96

Source: Calculated by the Consultant

Main conclusion of final and useful energy demand for the public buildings sub-sector are as following:

- Total final energy demand is increased from 486.23 GWh (2023) to 682.75 GWh (2050) for baseline scenario (BLS) (figure I-35). Meanwhile, total useful energy demand is 564.12 GWh (2050) for BLS (figure I-36).
- Total final space heating energy demand is increased from 284.20 GWh (2023) to 360.14 GWh (2050) for BLS (figure I-37). Meanwhile, total useful space heating energy demand is 280.45 GWh (2050) for BLS (figure I-38).
- Total final space cooling energy demand is increased from 43.81 GWh (2023) to 103.70 GWh (2050) for BLS (figure I-39). Meanwhile, total useful space cooling energy demand is 92.33 GWh (2050) for BLS (figure I-40).
- Total final water heating energy demand is increased from 49.42 GWh (2023) to 75.10 GWh (2050) for BLS (figure I-41). Meanwhile, total useful water heating energy demand is 67.51 GWh (2050) for BLS (figure I-42).

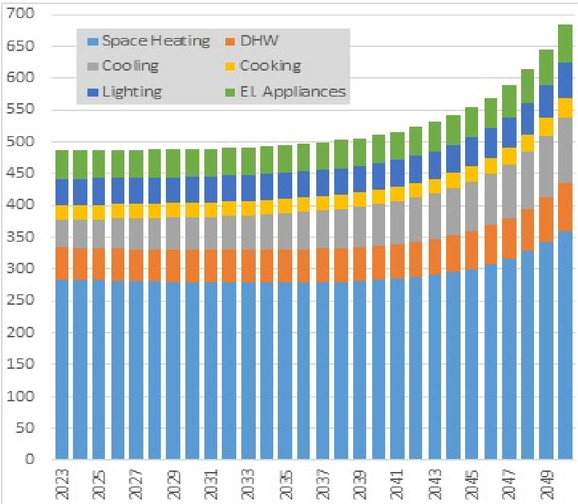


Figure I-35: Public Buildings Final Energy Services forecast for BL Scenario, in GWh

Source: Calculated by the Consultant

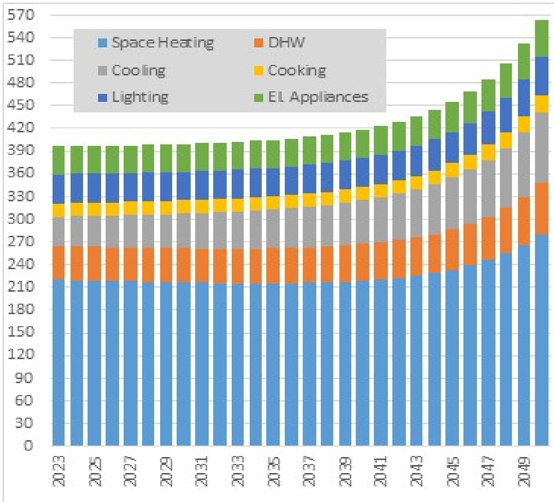


Figure I-36: Public Buildings Useful Energy Services forecast for BLS, in GWh

Source: Calculated by the Consultant

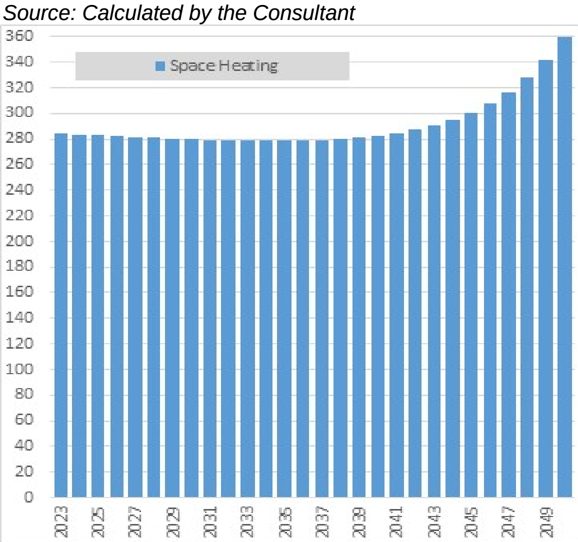


Figure I-37: Public Buildings Final Energy Heating forecast for BL Scenario, in GWh

Source: Calculated by the Consultant

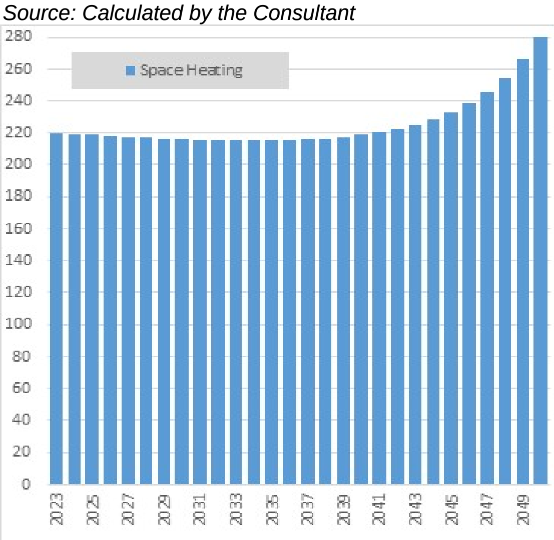


Figure I-38: Public Buildings Useful Space Heating forecast for BL Scenario, in GWh

Source: Calculated by the Consultant

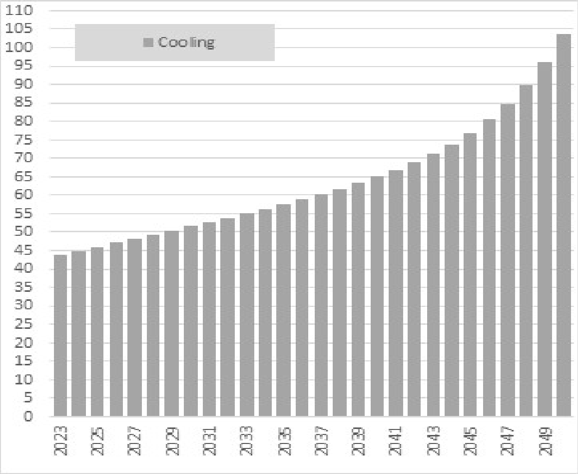


Figure I-39: Public Buildings Final Energy Cooling forecast for BL Scenario, in GWh
Source: Calculated by the Consultant

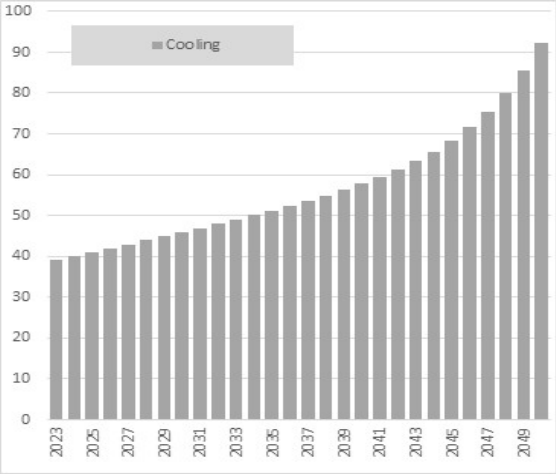


Figure I-40: Public Buildings Useful Space Cooling forecast for BL Scenario, in GWh
Source: Calculated by the Consultant

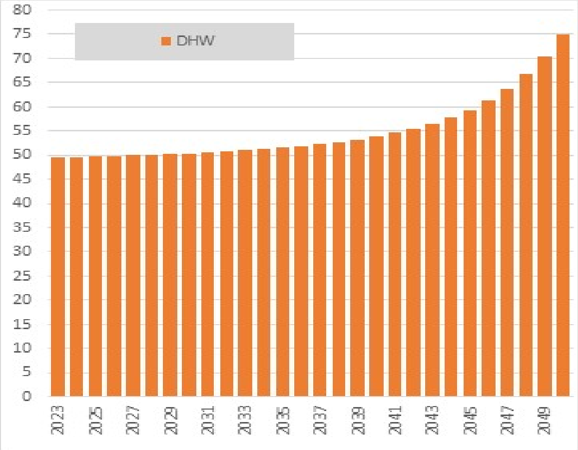


Figure I-41: Public Buildings Final Energy Water Heating forecast for BL Scenario, GWh
Source: Calculated by the Consultant

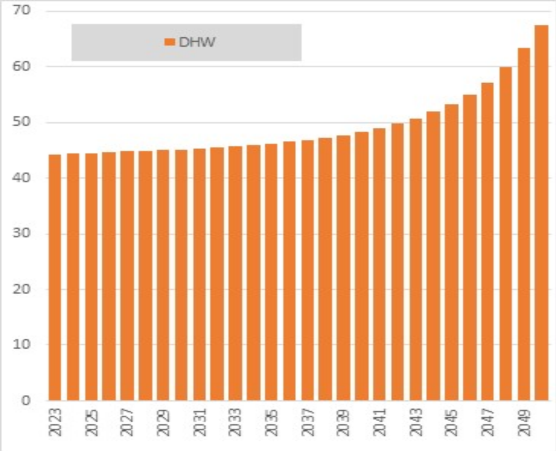


Figure I-42: Public Buildings Useful Water Heating forecast for BL Scenario, in GWh
Source: Calculated by the Consultant

I.2.3 Private Service and Commercial Buildings Service Sub-Sector

The Services Sector is divided into two subsectors according to EUROSTAT and INSTAT: 1) Public Services and 2) Private Services. Energy consumption in the Private Services Sector is influenced by various factors, including the number of buildings, their total area, type of buildings, the number of users, climatic zones, the technologies employed, their efficiencies, and the specific energy consumption associated with each energy service.

Figures I-43 - I-44 present the total final energy consumption for commercial and private service buildings for the years 2015 - 2023. Since the national energy statistics do not provide separate data for the commercial and private service sectors, the yearly energy consumption for private services and commercial building stock is calculated by subtracting the yearly energy consumption of public building stock (analyzed in session above) from the total service sector energy consumption.

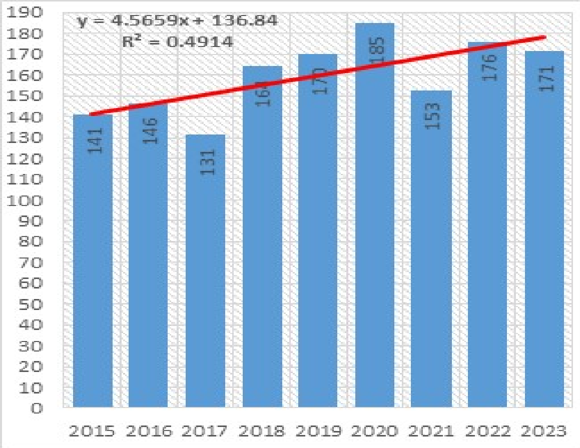


Figure I-43: Progress of final energy consumption for commercial and private service buildings for the years 2015-2023 (ktoe)

Source: Calculated by the Consultant based on the Energy Balance 2015-2023, INSTAT, and MIE/AKBN

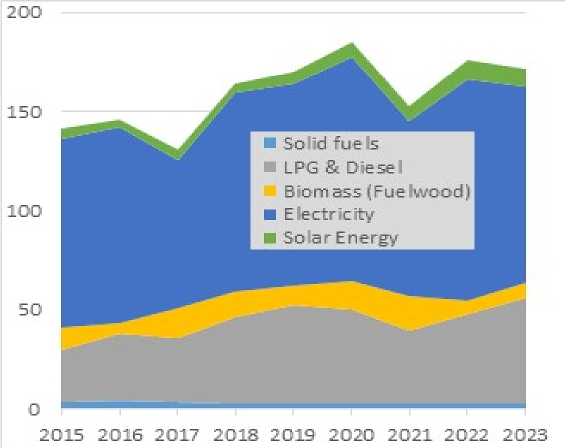


Figure I-44: Progress of final energy consumption for commercial and private service buildings for the years 2015-2023 (ktoe)

Source: Calculations made by the Consultant based on the Albanian Energy Balance 2015-2023, INSTAT, and MIE/AKBN

The analysis shows a significant increase of the energy consumption in this sector and a temporary reduction of the consumption in 2021 due to Covid-19. The main source of detailed information on types of buildings in the private services and commercial building stock is INSTAT and it can be broken down into the following main categories:

- Wholesale and retail trade (shops, stores and supermarkets);
- Private office of various professions;
- Private kindergarten/school/universities;
- Hotels and restaurants;
- Buildings of the private health sector; and
- Buildings and premises for cultural, sports and other activities (not included in categories above).

Detailed data is not available for the breakdown of the private services and commercial building stock by age, size, ownership, location or typologies. Also, detailed information is not readily available on building materials (although they are mostly masonry construction), thermophysical characteristics of building structures (insulation, glazing, ventilation, daylighting), or heating, cooling and lighting systems. Therefore, the following data was calculated based on INSTAT data and the Consultant's team experience. Given the low amount of data available, a number of assumptions were made, either drawn from previous energy audits prepared by the consultant or based on international experience. The private services and commercial building stock in Albania are very heterogeneous due to differences in average areas, types of construction, types of occupancy and energy consumption, depending on use. Total private services and commercial building stock based on the annual INSTAT data was 85,098 for the year 2023[6]. The electricity demand for private service and commercial buildings was forecasted to cover part of space heating, water heating and cooking as well as fully the following three other services: lighting, space cooling and electrical equipment by carrying out calculation based on the following five steps below:

Step 1: The analysis of the actual situation related to the private service and commercial buildings stock from construction and energy consumption point of view. According to the analysis presented under the LTBRAP the following overview based on the age of the buildings might be presented:

- Only 5% of private stock is older than 50 years;
- About 10% of the private buildings were constructed during the period 1965-'90 according to the construction norms at that time and appropriate quality from thermal point of view from this period;
- 30% of the private buildings have been constructed between 1991-2010, usually at a low quality;
- 55% of private buildings have been constructed between 2011-2025, usually with medium quality.

Performance of heating devices varies, for example: very few are using the condensing boilers, medium share of heat pump mode at AC units and wood pellet boilers of medium/high efficiency.

[6] https://www.instat.gov.al/media/1826/regjistri_i_ndermarrjeve_ekonomike (economic register of all enterprises)

Application of solar collectors for SHW as well as lately PV Autoproducers is increasing very fast, due to increasing awareness, availability technologies and efforts by international donor projects and state budget secured by MIE and implemented by the Energy Efficiency Agency. Private service and commercial buildings fforecast was carried out based Long Term Building Renovation Action Plan (approved on February 2025) and on the trend development of capita/dwellings. Number and area of private service and commercial buildings will be used as the driving factor for calculation of electricity demand at municipality level for each climatic zone of Albania. Energy consumption in the private service and commercial buildings sub-sector is depended on several factors:

- Number of private service and commercial buildings;
- Average area of private service and commercial building according to the category;
- Distribution of private buildings per each climatic zone 1, 2, 3, of different type of private buildings: i) wholesale and retail trade; ii) private office of various professions iii) private kindergarten/school/universities ; iv) hotels and restaurants; v) buildings of the private health sector and vi) sports and other activities.

The following sections will provide the analysis of these parameters and their breakdown in three climatic zones: 1, 2, and 3. The calculations have been made based on the concept of Heating Degree Days (HDD), taking into consideration all type of private buildings and six energy services (purposes) covering the basic energy services: space heating, space cooling, water heating, lighting, cooking and electric equipment.

Step 2: Private Service and Commercial Building Stock Forecast is based on Long Term Building Renovation Action Plan for the period 2023-2050 and extrapolated with lower growth rate by the consultant for the period 2051-2060. Results for the whole Albanian private building stock for each building category are presented at the figures I-45 - I-48.

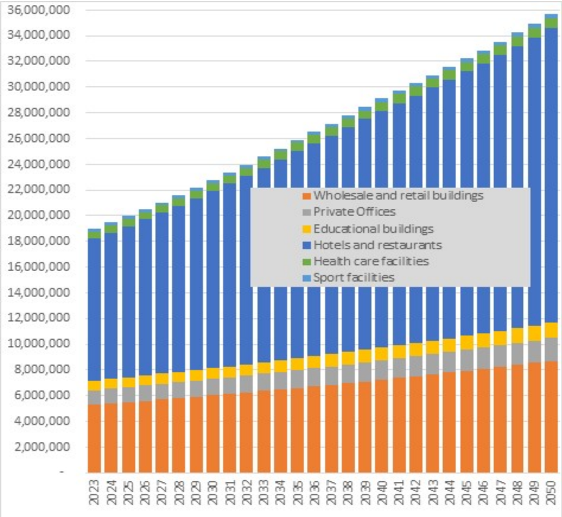


Figure I-45: Total forecasted floor area (m^2) of Private Building Stock for the whole Albania according to different categories
Source: Calculations performed by the Consultant

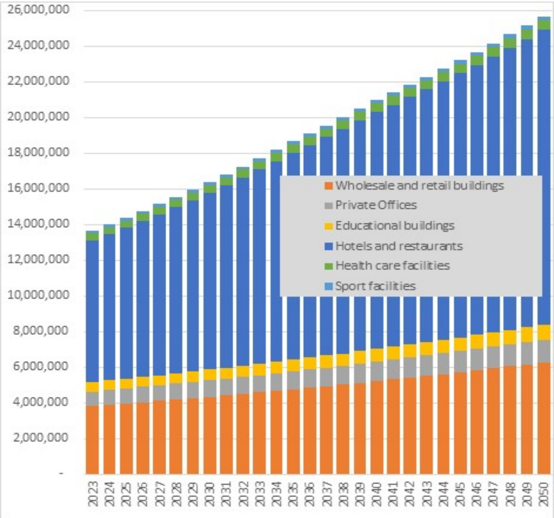


Figure I-46: Forecasted floor area (m^2) of Private Building Stock for Zone 1 according to different categories
Source: Calculations performed by the Consultant

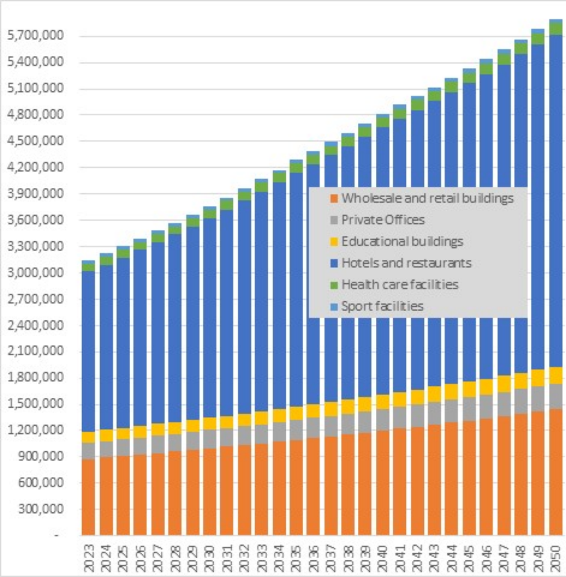


Figure I-47: Forecasted floor area (m²) of Private Building Stock for Zone 2 according to different categories
Source: Calculations performed by the Consultant

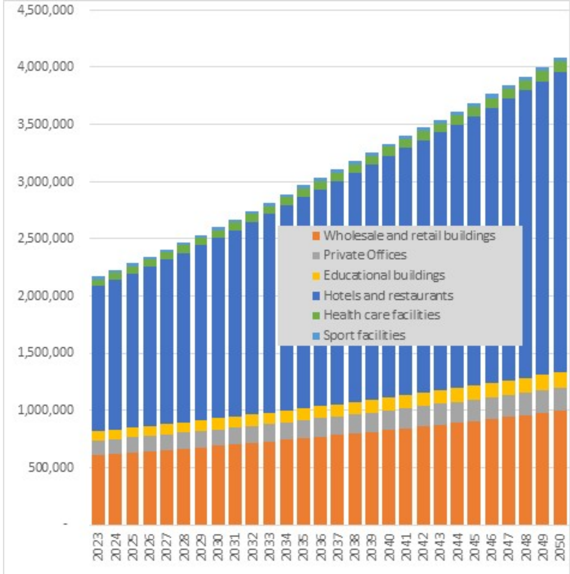


Figure I-48: Forecasted floor area (m²) of Private Building Stock for Zone 3 according to different categories
Source: Calculations performed by the Consultant

Step 3: Shares of Energy Commodities for each private building sub-category under each climatic zone for 2023 are based on the figures of the Yearly Energy Balance and are calculated by the consultant and expressed in %. Forecasted of share of the energy commodities, for each private building sub-category under each climatic zone, for three scenarios: Baseline scenario, NECP/WEM and NECP/WAM are based on the assumptions undertaken under the Strategy of Energy, LTBRAP and revised document of NECP. All respective figures and assumptions are presented at Table I-21.

Table I-21: Breakdown of total private buildings energy commodities on building categories for each climatic zone

Energy Commodities (EC)	Values of EC for 2023, GWh	Shares of EC for 2023, %	Forecasted of EC for BLS for 2050, %	Values of EC for 2023, GWh	Shares of EC for 2023, %	Forecasted of EC for BLS for 2050, %
Zone 1: *Wholesale and retail trade*				Zone 2: Wholesale and retail trade		
Solid fuels	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Natural Gas	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Oil by Products	116.87	44.18%	53.34%	12.66	15.39%	18.58%
Fuelwood	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Electricity	136.74	51.69%	41.68%	67.09	81.57%	77.75%
Solar Energy	10.92	4.13%	4.98%	2.50	3.04%	3.67%
Derived Heat	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Zone 1:*Private office of various professions*				Zone 2:*Pr. office of various professions*		
Solid fuels	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Natural Gas	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Oil by Products	29.58	44.18%	53.34%	3.21	15.41%	18.60%
Fuelwood	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Electricity	26.57	39.68%	27.18%	15.47	74.26%	68.93%
Solar Energy	10.80	16.13%	19.48%	2.15	10.33%	12.47%
Derived Heat	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Zone 1: *Private kindergarten/school/universities*				Zone 2: *Pr. kindergarten/school/univers.*		
Solid fuels	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Natural Gas	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Oil by Products	21.19	44.18%	53.34%	2.30	15.43%	18.63%
Fuelwood	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Electricity	24.48	51.04%	40.90%	11.43	76.62%	71.77%
Solar Energy	2.29	4.78%	5.77%	1.19	7.95%	9.60%
Derived Heat	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Zone 1: *Hotels and restaurants*				Zone 2: *Hotels and restaurants*		
Solid fuels	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Natural Gas	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Oil by Products	345.08	44.96%	54.28%	37.36	15.78%	19.06%
Fuelwood	29.17	3.80%	4.59%	35.99	15.21%	18.36%

Electricity	362.78	47.27%	36.34%	143.87	60.79%	52.66%
Solar Energy	30.50	3.97%	4.80%	19.47	8.22%	9.93%
Derived Heat	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Zone 1: *Buildings of the private health sector*				*Zone 2:* Buildings of the private health sector		
Solid fuels	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Natural Gas	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Oil by Products	16.20	44.62%	53.87%	1.73	15.36%	18.54%
Fuelwood	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Electricity	16.31	44.94%	33.53%	6.92	61.34%	53.33%
Solar Energy	3.79	10.44%	12.61%	2.63	23.30%	28.13%
Derived Heat	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Zone 1: *Sports and other activities*				Zone 2: *Sports and other activities*		
Solid fuels	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Natural Gas	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Oil by Products	0.15	1.75%	2.11%	0.42	15.52%	18.73%
Fuelwood	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Electricity	7.47	86.29%	83.45%	1.74	64.66%	57.33%
Solar Energy	1.03	11.96%	14.44%	0.53	19.83%	23.94%
Derived Heat	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Zone 3: Wholesale and retail trade				Zone 3: *Private office of various professions*		
Solid fuels	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Natural Gas	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Oil by Products	7.97	8.82%	10.64%	1.94	8.49%	10.25%
Fuelwood	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Electricity	80.92	89.57%	87.41%	18.66	81.64%	77.83%
Solar Energy	1.45	1.61%	1.94%	2.26	9.87%	11.91%
Derived Heat	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Zone 3: Private kindergarten/school/universities				Zone 3: Hotels and restaurants		
Solid fuels	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Natural Gas	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Oil by Products	1.50	9.16%	11.05%	23.70	9.00%	10.87%
Fuelwood	0.00	0.00%	0.00%	32.10	12.20%	14.72%
Electricity	13.86	84.60%	81.41%	198.53	75.43%	70.33%
Solar Energy	1.02	6.25%	7.54%	8.88	3.38%	4.07%
Derived Heat	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Zone 3: *Buildings of the private health sector*				Zone 3: *Sports and other activities*		
Solid fuels	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Natural Gas	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Oil by Products	1.10	8.90%	10.75%	0.26	8.70%	10.50%
Fuelwood	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Electricity	9.98	80.41%	76.35%	2.42	82.21%	78.53%
Solar Energy	1.33	10.68%	12.90%	0.27	9.09%	10.97%
Derived Heat	0.00	0.00%	0.00%	0.00	0.00%	0.00%

Source: Calculations performed by the Consultant

Step 4: Breakdown of energy commodities for each of the Private Service and Commercial Building sub-categories under each climatic zone on the respective energy services: 1) Space Heating; 2) Domestic Hot Water (DHW); 3) Space Cooling; 4) Cooking; 5) Lighting; and 6) Electrical Appliances are presented for each scenario at the table I-22. Forecasted of share of the energy services, for each private building sub-category under each climatic zone, for three scenarios: Baseline scenario, NECP/WEM and NECP/WAM are based on the calculations of each respective referent public buildings undertaken under the LTBRAP.

Table I-22: Breakdown of energy commodities for each of the Private Service and Commercial Building sub-categories under each climatic zone on the respective energy services

Energy Services(EC)	Values of ES for 2023, GWh	Shares of ES for 2023, %	Forecasted of ES for BLS for 2050, %	Values of ES for 2023, GWh	Shares of ES for 2023, %	Forecasted of ES for BLS for 2050, %
Zone 1: *Wholesale and retail trade*				Zone 2: Wholesale and retail trade		
Space Heating	94.58	35.75%	32.97%	36.89	44.85%	41.35%
DHW	32.60	12.33%	13.01%	9.15	11.12%	11.73%
Cooling	35.63	13.47%	18.57%	7.65	9.30%	14.88%
Cooking	30.43	11.50%	10.61%	8.46	10.28%	9.48%
Lighting	36.52	13.80%	12.73%	10.29	12.51%	11.53%
El. Appliances	34.78	13.15%	12.12%	9.83	11.95%	11.02%
Zone 1:*Private office of various professions*				Zone 2:*Pr. office of various professions*		
Space Heating	24.68	36.86%	33.99%	10.01	48.07%	44.33%
DHW	2.67	3.99%	4.21%	0.73	3.50%	3.69%
Cooling	11.55	17.26%	23.15%	2.41	11.59%	18.01%
Cooking	6.01	8.98%	8.28%	1.64	7.87%	7.26%

Lighting	11.37	16.98%	15.65%	3.12	14.96%	13.79%
El. Appliances	10.68	15.96%	14.72%	2.92	14.00%	12.91%
Zone 1: *Private kindergarten/school/universities*				Zone 2: *Pr. kindergarten/school/univers.*		
Space Heating	247.29	32.22%	49.00%	8.86	59.36%	54.74%
DHW	139.82	18.22%	12.51%	1.69	11.32%	11.94%
Cooling	57.89	7.54%	17.66%	1.15	7.68%	13.36%
Cooking	186.43	24.29%	2.73%	0.42	2.83%	2.61%
Lighting	80.18	10.45%	14.00%	2.17	14.57%	13.43%
El. Appliances	55.93	7.29%	4.10%	0.63	4.24%	3.91%
Zone 1: *Hotels and restaurants*				Zone 2: *Hotels and restaurants*		
Space Heating	19.34	53.29%	29.71%	95.72	40.44%	37.29%
DHW	2.21	6.10%	19.23%	38.87	16.42%	17.33%
Cooling	4.56	12.56%	12.32%	12.32	5.21%	10.40%
Cooking	2.21	6.10%	22.40%	51.83	21.90%	20.19%
Lighting	4.65	12.81%	9.63%	22.40	9.46%	8.73%
El. Appliances	3.32	9.15%	6.72%	15.55	6.57%	6.06%
Zone 1: *Buildings of the private health sector*				*Zone 2:* Buildings of the private health sector		
Space Heating	5.29	61.18%	49.14%	7.09	62.86%	57.96%
DHW	0.36	4.12%	6.44%	0.58	5.17%	5.46%
Cooling	1.25	14.40%	18.56%	0.92	8.14%	14.61%
Cooking	0.00	0.00%	5.62%	0.58	5.17%	4.77%
Lighting	1.34	15.50%	11.81%	1.23	10.91%	10.06%
El. Appliances	0.42	4.81%	8.44%	0.87	7.75%	7.15%
Zone 1: *Sports and other activities*				Zone 2: *Sports and other activities*		
Space Heating	0.00	0.00%	56.41%	1.90	70.56%	65.07%
DHW	0.00	0.00%	4.35%	0.09	3.41%	3.60%
Cooling	0.15	1.75%	20.52%	0.25	9.14%	15.76%
Cooking	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Lighting	7.47	86.29%	14.29%	0.35	12.91%	11.90%
El. Appliances	1.03	11.96%	4.43%	0.11	3.98%	3.67%
Zone 3: Wholesale and retail trade				Zone 3: *Private office of various professions*		
Space Heating	51.96	57.52%	53.04%	14.27	62.42%	57.55%
DHW	7.98	8.84%	9.33%	0.61	2.65%	2.80%
Cooling	5.15	5.70%	11.88%	1.55	6.77%	13.68%
Cooking	7.26	8.03%	7.41%	1.35	5.90%	5.44%
Lighting	9.26	10.25%	9.45%	2.67	11.67%	10.76%
El. Appliances	8.71	9.64%	8.89%	2.42	10.60%	9.77%
Zone 3: Private kindergarten/school/universities				Zone 3: Hotels and restaurants		
Space Heating	12.18	74.37%	68.58%	139.86	53.14%	48.99%
DHW	1.43	8.75%	9.24%	35.02	13.30%	14.04%
Cooling	0.60	3.67%	10.01%	6.85	2.60%	8.42%
Cooking	0.36	2.19%	2.02%	46.69	17.74%	16.35%
Lighting	1.27	7.74%	7.14%	20.80	7.90%	7.29%
El. Appliances	0.54	3.28%	3.03%	14.01	5.32%	4.91%
Zone 3: *Buildings of the private health sector*				Zone 3: *Sports and other activities*		
Space Heating	9.28	74.76%	68.93%	2.39	81.27%	74.94%
DHW	0.47	3.80%	4.01%	0.07	2.43%	2.56%
Cooling	0.46	3.70%	10.69%	0.12	4.01%	11.17%
Cooking	0.47	3.80%	3.50%	0.00	0.00%	0.00%
Lighting	1.02	8.26%	7.61%	0.28	9.46%	8.72%
El. Appliances	0.71	5.69%	5.25%	0.08	2.83%	2.61%

Source: Calculations performed by the Consultant

Step 5: Forecast of energy demand for residential sector up to 2050 is calculated based on the energy intensities for all energy commodities according to the energy strategy for the period 2023-2050 for each referent building under each climatic zone. The respective energy intensity values of the energy services for period 2023-2050 are presented at the Table I-23.

Table I-23: Actual and forecasted energy intensity values on Private Service and Commercial Building Stock sub-sector (kWh/Euro)

Private buildings categories	2023	2030	2035	2040	2045	2050
ZONE 1	*87.31*	*85.53*	*84.25*	*82.82*	*81.27*	*79.72*
Wholesale and retail trade	*69.43*	*67.63*	*66.35*	*65.06*	*63.77*	*62.49*
Private office of various professions	*82.10*	*79.98*	*78.45*	*76.93*	*75.41*	*73.89*
Private kindergarten/school/universities	*89.25*	*86.94*	*85.28*	*83.63*	*81.98*	*80.33*
Hotels and restaurants	*96.56*	*94.06*	*92.27*	*90.48*	*88.69*	*86.90*
Buildings of the private health	*93.69*	*91.26*	*89.53*	*87.79*	*86.06*	*84.32*
Sports and other activities	*56.57*	*55.10*	*54.05*	*53.01*	*51.96*	*50.91*

ZONE 2	*117.48*	*115.07*	*113.32*	*111.40*	*109.31*	*107.21*
Wholesale and retail trade	*93.93*	*91.50*	*89.76*	*88.02*	*86.28*	*84.54*
Private office of various professions	*111.10*	*108.22*	*106.16*	*104.11*	*102.05*	*99.99*
Private kindergarten/school/universities	*120.70*	*117.57*	*115.34*	*113.10*	*110.87*	*108.63*
Hotels and restaurants	*129.54*	*126.18*	*123.78*	*121.38*	*118.98*	*116.58*
Buildings of the private health	*126.73*	*123.45*	*121.10*	*118.75*	*116.40*	*114.06*
Sports and other activities	*76.51*	*74.53*	*73.11*	*71.70*	*70.28*	*68.86*
ZONE 3	*187.99*	*184.19*	*181.43*	*178.37*	*175.03*	*171.69*
Wholesale and retail trade	*149.09*	*145.22*	*142.46*	*139.70*	*136.94*	*134.18*
Private office of various professions	*176.28*	*171.71*	*168.44*	*165.18*	*161.92*	*158.65*
Private kindergarten/school/universities	*191.61*	*186.64*	*183.10*	*179.55*	*176.00*	*172.45*
Hotels and restaurants	*208.22*	*202.82*	*198.96*	*195.11*	*191.25*	*187.40*
Buildings of the private health	*201.29*	*196.07*	*192.34*	*188.62*	*184.89*	*181.16*
Sports and other activities	*121.61*	*118.45*	*116.20*	*113.95*	*111.70*	*109.44*
Total	*103.90*	*101.78*	*100.24*	*98.54*	*96.70*	*94.85*

Source: Calculated by the Consultant

Step 6: Carry out the Final Energy Demand Forecast, for each energy commodity, for each private building subcategory and for each climatic zone based on the formula:

EnergyComm.$_{demand}$ = activity level x share of energy commodity x energy intensity for each private building subcategory and for each climatic zone.

Calculation of final energy demand was carried out based on the entire data mentioned on all steps above for each private building sub-category, each energy service and the respective values are presented at the Table I-24.

Table I-24: Forecast final energy demand (GWh/year), for private buildings category, under each climatic zone and for each scenario

Private Buildings sub-sector	2023	2030	2035	2040	2045	2050
ZONE 1						
Wholesale and retail trade						
Solid fuels	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00
Oil by Products	116.87	135.96	151.43	168.59	187.63	208.73
Fuelwood	0.00	0.00	0.00	0.00	0.00	0.00
Electricity	136.74	144.41	149.65	154.58	159.11	163.12
Solar Energy	10.92	12.70	14.15	15.75	17.53	19.50
Derived Heat	0.00	0.00	0.00	0.00	0.00	0.00
Private office of various professions						
Solid fuels	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00
Oil by Products	29.58	34.01	37.56	41.47	45.76	50.48
Fuelwood	0.00	0.00	0.00	0.00	0.00	0.00
Electricity	26.57	26.88	26.91	26.75	26.37	25.73
Solar Energy	10.80	12.42	13.72	15.14	16.71	18.43
Derived Heat	0.00	0.00	0.00	0.00	0.00	0.00
Private kindergarten/school/universities						
Solid fuels	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00
Oil by Products	21.19	24.36	26.90	29.70	32.77	36.15
Fuelwood	0.00	0.00	0.00	0.00	0.00	0.00
Electricity	24.48	25.51	26.19	26.79	27.31	27.72
Solar Energy	2.29	2.63	2.91	3.21	3.54	3.91
Derived Heat	0.00	0.00	0.00	0.00	0.00	0.00
Hotels and restaurants						
Solid fuels	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00
Oil by Products	345.08	440.29	523.89	608.00	688.15	778.53
Fuelwood	29.17	37.22	44.29	51.40	58.18	65.82
Electricity	362.78	416.20	457.19	487.96	505.68	521.20
Solar Energy	30.50	38.92	46.30	53.74	60.82	68.81
Derived Heat	0.00	0.00	0.00	0.00	0.00	0.00
Buildings of the private health						
Solid fuels	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00
Oil by Products	16.20	18.19	19.76	21.45	23.27	25.24

Fuelwood	0.00	0.00	0.00	0.00	0.00	0.00
Electricity	16.31	16.38	16.34	16.22	16.02	15.71
Solar Energy	3.79	4.26	4.62	5.02	5.45	5.91
Derived Heat	0.00	0.00	0.00	0.00	0.00	0.00
Sports and other activities						
Solid fuels	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00
Oil by Products	0.15	0.17	0.18	0.20	0.22	0.24
Fuelwood	0.00	0.00	0.00	0.00	0.00	0.00
Electricity	7.47	7.91	8.24	8.59	8.94	9.30
Solar Energy	1.03	1.16	1.26	1.37	1.48	1.61
Derived Heat	0.00	0.00	0.00	0.00	0.00	0.00
ZONE 2						
Wholesale and retail trade						
Solid fuels	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00
Oil by Products	12.66	14.73	16.41	18.27	20.33	22.62
Fuelwood	0.00	0.00	0.00	0.00	0.00	0.00
Electricity	67.09	73.50	78.38	83.52	88.93	94.62
Solar Energy	2.50	2.91	3.24	3.61	4.01	4.47
Derived Heat	0.00	0.00	0.00	0.00	0.00	0.00
Private office of various professions						
Solid fuels	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00
Oil by Products	3.21	3.69	4.07	4.50	4.96	5.48
Fuelwood	0.00	0.00	0.00	0.00	0.00	0.00
Electricity	15.47	16.64	17.51	18.41	19.34	20.29
Solar Energy	2.15	2.47	2.73	3.02	3.33	3.67
Derived Heat	0.00	0.00	0.00	0.00	0.00	0.00
Private kindergarten/school/universities						
Solid fuels	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00
Oil by Products	2.30	2.64	2.92	3.22	3.56	3.93
Fuelwood	0.00	0.00	0.00	0.00	0.00	0.00
Electricity	11.43	12.31	12.98	13.67	14.39	15.12
Solar Energy	1.19	1.36	1.50	1.66	1.83	2.02
Derived Heat	0.00	0.00	0.00	0.00	0.00	0.00
Hotels and restaurants						
Solid fuels	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00
Oil by Products	37.36	47.67	56.72	65.83	74.50	84.29
Fuelwood	35.99	45.92	54.64	63.41	71.77	81.19
Electricity	143.87	169.17	189.56	206.85	219.75	232.92
Solar Energy	19.47	24.84	29.55	34.30	38.82	43.91
Derived Heat	0.00	0.00	0.00	0.00	0.00	0.00
Buildings of the private health						
Solid fuels	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00
Oil by Products	1.73	1.95	2.11	2.30	2.49	2.70
Fuelwood	0.00	0.00	0.00	0.00	0.00	0.00
Electricity	6.92	7.17	7.34	7.50	7.64	7.77
Solar Energy	2.63	2.95	3.21	3.48	3.78	4.10
Derived Heat	0.00	0.00	0.00	0.00	0.00	0.00
Sports and other activities						
Solid fuels	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00
Oil by Products	0.42	0.47	0.51	0.55	0.60	0.65
Fuelwood	0.00	0.00	0.00	0.00	0.00	0.00
Electricity	1.74	1.81	1.85	1.90	1.95	1.99
Solar Energy	0.53	0.60	0.65	0.70	0.76	0.83
Derived Heat	0.00	0.00	0.00	0.00	0.00	0.00
ZONE 3						
Wholesale and retail trade						
Solid fuels	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00
Oil by Products	7.97	9.27	10.32	11.49	12.79	14.22
Fuelwood	0.00	0.00	0.00	0.00	0.00	0.00
Electricity	80.92	89.12	95.44	102.15	109.27	116.82
Solar Energy	1.45	1.69	1.88	2.10	2.33	2.60

Derived Heat	0.00	0.00	0.00	0.00	0.00	0.00
Private office of various professions						
Solid fuels	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00
Oil by Products	1.94	2.23	2.47	2.72	3.00	3.31
Fuelwood	0.00	0.00	0.00	0.00	0.00	0.00
Electricity	18.66	20.20	21.37	22.58	23.84	25.15
Solar Energy	2.26	2.59	2.86	3.16	3.49	3.85
Derived Heat	0.00	0.00	0.00	0.00	0.00	0.00
Private kindergarten/school/universities						
Solid fuels	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00
Oil by Products	1.50	1.72	1.90	2.10	2.32	2.56
Fuelwood	0.00	0.00	0.00	0.00	0.00	0.00
Electricity	13.86	15.03	15.92	16.85	17.82	18.84
Solar Energy	1.02	1.18	1.30	1.43	1.58	1.74
Derived Heat	0.00	0.00	0.00	0.00	0.00	0.00
Hotels and restaurants						
Solid fuels	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00
Oil by Products	23.70	30.23	35.97	41.75	47.25	53.46
Fuelwood	32.10	40.96	48.74	56.56	64.02	72.43
Electricity	198.53	237.29	269.30	297.92	321.21	345.95
Solar Energy	8.88	11.33	13.49	15.65	17.71	20.04
Derived Heat	0.00	0.00	0.00	0.00	0.00	0.00
Buildings of the private health						
Solid fuels	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00
Oil by Products	1.10	1.24	1.35	1.46	1.59	1.72
Fuelwood	0.00	0.00	0.00	0.00	0.00	0.00
Electricity	9.98	10.54	10.95	11.37	11.79	12.22
Solar Energy	1.33	1.49	1.62	1.75	1.90	2.06
Derived Heat	0.00	0.00	0.00	0.00	0.00	0.00
Sports and other activities						
Solid fuels	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00
Oil by Products	0.26	0.29	0.31	0.34	0.37	0.40
Fuelwood	0.00	0.00	0.00	0.00	0.00	0.00
Electricity	2.42	2.57	2.67	2.78	2.88	2.99
Solar Energy	0.27	0.30	0.33	0.36	0.39	0.42
Derived Heat	0.00	0.00	0.00	0.00	0.00	0.00

Source: Calculated by the Consultant

Step 7: Carry out the Final Energy Demand Forecast for private service buildings for each energy service category: 1) Space Heating; 2) Domestic Hot Water (DHW); 3) Space Cooling; 4) Cooking; 5) Lighting; and 6) Electrical Appliances for each private buildings subcategory and for each climatic zone based on the formula:

> $EnergyService._{demand}$ = activity level x share of energy service x energy intensity for each private building subcategory and for each climatic zone.

Calculation of final energy service demand was carried out based on the entire data mentioned on all steps above for each building sub-category, for each energy service and the respective values are presented at the Table I-25.

Table I-25: Forecast final energy demand (GWh/year), for each energy service, for each private buildings categories, under each climatic zone and for baseline scenario

Private Buildings sub-sector	2023	2030	2035	2040	2045	2050
ZONE 1						
Wholesale and retail trade						
Space Heating	94.58	102.60	108.71	115.14	121.90	129.01
DHW	32.60	36.63	39.80	43.22	46.92	50.91
Cooling	35.63	43.49	49.79	56.73	64.33	72.66
Cooking	30.43	33.01	34.98	37.05	39.22	41.51
Lighting	36.52	39.61	41.97	44.46	47.07	49.81
El. Appliances	34.78	37.73	39.98	42.34	44.83	47.44
Private office of various professions						

Space Heating	24.68	26.46	27.80	29.20	30.65	32.17
DHW	2.67	2.97	3.19	3.44	3.70	3.99
Cooling	11.55	13.79	15.58	17.52	19.63	21.91
Cooking	6.01	6.44	6.77	7.11	7.46	7.83
Lighting	11.37	12.19	12.80	13.45	14.12	14.81
El. Appliances	10.68	11.45	12.04	12.64	13.27	13.93
Private kindergarten/school/universities						
Space Heating	25.48	27.32	28.70	30.15	31.65	33.21
DHW	5.68	6.31	6.80	7.32	7.88	8.48
Cooling	5.95	7.26	8.29	9.42	10.64	11.97
Cooking	1.42	1.52	1.60	1.68	1.76	1.85
Lighting	7.28	7.81	8.20	8.61	9.04	9.49
El. Appliances	2.13	2.29	2.40	2.52	2.65	2.78
Hotels and restaurants						
Space Heating	247.29	294.23	333.06	367.72	395.93	426.13
DHW	139.82	172.29	199.96	226.36	249.90	275.78
Cooling	57.89	82.35	104.26	127.43	150.60	176.67
Cooking	186.43	221.81	251.08	277.21	298.48	321.24
Lighting	80.18	95.40	107.99	119.23	128.37	138.17
El. Appliances	55.93	66.54	75.32	83.16	89.54	96.37
Buildings of the private health						
Space Heating	19.34	20.26	20.93	21.61	22.31	23.02
DHW	2.21	2.40	2.54	2.69	2.85	3.02
Cooling	4.56	5.50	6.23	7.00	7.82	8.69
Cooking	2.21	2.32	2.40	2.47	2.55	2.64
Lighting	4.65	4.87	5.03	5.20	5.36	5.53
El. Appliances	3.32	3.48	3.59	3.71	3.83	3.95
Sports and other activities						
Space Heating	5.29	5.53	5.72	5.90	6.09	6.29
DHW	0.36	0.39	0.41	0.43	0.46	0.48
Cooling	1.25	1.48	1.67	1.86	2.07	2.29
Cooking	0.00	0.00	0.00	0.00	0.00	0.00
Lighting	1.34	1.40	1.45	1.50	1.54	1.59
El. Appliances	0.42	0.43	0.45	0.46	0.48	0.49
ZONE 2						
Wholesale and retail trade						
Space Heating	36.89	40.02	42.41	44.92	47.55	50.33
DHW	9.15	10.28	11.16	12.12	13.16	14.28
Cooling	7.65	9.84	11.61	13.57	15.73	18.11
Cooking	8.46	9.18	9.72	10.30	10.90	11.54
Lighting	10.29	11.16	11.83	12.53	13.26	14.04
El. Appliances	9.83	10.66	11.30	11.97	12.67	13.41
Private office of various professions						
Space Heating	10.01	10.73	11.28	11.84	12.43	13.05
DHW	0.73	0.81	0.87	0.94	1.01	1.09
Cooling	2.41	3.03	3.53	4.07	4.66	5.30
Cooking	1.64	1.76	1.85	1.94	2.04	2.14
Lighting	3.12	3.34	3.51	3.69	3.87	4.06
El. Appliances	2.92	3.13	3.28	3.45	3.62	3.80
Private kindergarten/school/universities						
Space Heating	8.86	9.49	9.97	10.47	10.99	11.53
DHW	1.69	1.87	2.02	2.17	2.34	2.52
Cooling	1.15	1.50	1.79	2.10	2.44	2.82
Cooking	0.42	0.45	0.48	0.50	0.52	0.55
Lighting	2.17	2.33	2.45	2.57	2.70	2.83
El. Appliances	0.63	0.68	0.71	0.75	0.79	0.82
Hotels and restaurants						
Space Heating	95.72	113.89	128.91	142.33	153.25	164.94
DHW	38.87	47.90	55.59	62.93	69.47	76.67
Cooling	12.32	19.00	25.06	31.63	38.38	46.01
Cooking	51.83	61.67	69.80	77.07	82.98	89.31
Lighting	22.40	26.65	30.17	33.30	35.86	38.59
El. Appliances	15.55	18.50	20.94	23.12	24.89	26.79
Buildings of the private health						
Space Heating	7.09	7.43	7.68	7.93	8.18	8.44
DHW	0.58	0.63	0.67	0.71	0.75	0.79
Cooling	0.92	1.19	1.40	1.63	1.87	2.13
Cooking	0.58	0.61	0.63	0.65	0.67	0.69
Lighting	1.23	1.29	1.33	1.38	1.42	1.47

El. Appliances	0.87	0.92	0.95	0.98	1.01	1.04
Sports and other activities						
Space Heating	1.90	1.98	2.05	2.12	2.19	2.25
DHW	0.09	0.10	0.11	0.11	0.12	0.12
Cooling	0.25	0.31	0.37	0.42	0.48	0.55
Cooking	0.00	0.00	0.00	0.00	0.00	0.00
Lighting	0.35	0.36	0.37	0.39	0.40	0.41
El. Appliances	0.11	0.11	0.12	0.12	0.12	0.13
ZONE 3						
Wholesale and retail trade						
Space Heating	51.96	56.37	59.73	63.26	66.98	70.88
DHW	7.98	8.97	9.74	10.58	11.49	12.47
Cooling	5.15	7.37	9.17	11.18	13.41	15.87
Cooking	7.26	7.87	8.34	8.84	9.36	9.90
Lighting	9.26	10.05	10.64	11.27	11.94	12.63
El. Appliances	8.71	9.45	10.01	10.60	11.23	11.88
Private office of various professions						
Space Heating	14.27	15.30	16.07	16.88	17.72	18.60
DHW	0.61	0.67	0.72	0.78	0.84	0.90
Cooling	1.55	2.16	2.65	3.18	3.77	4.42
Cooking	1.35	1.45	1.52	1.60	1.68	1.76
Lighting	2.67	2.86	3.00	3.16	3.31	3.48
El. Appliances	2.42	2.60	2.73	2.87	3.01	3.16
Private kindergarten/school/universities						
Space Heating	12.18	13.05	13.71	14.40	15.12	15.87
DHW	1.43	1.59	1.71	1.85	1.99	2.14
Cooling	0.60	0.96	1.25	1.57	1.93	2.32
Cooking	0.36	0.38	0.40	0.42	0.44	0.47
Lighting	1.27	1.36	1.43	1.50	1.57	1.65
El. Appliances	0.54	0.58	0.61	0.64	0.67	0.70
Hotels and restaurants						
Space Heating	139.86	166.40	188.36	207.96	223.91	240.99
DHW	35.02	43.14	50.07	56.69	62.58	69.06
Cooling	6.85	13.32	19.32	26.08	33.24	41.41
Cooking	46.69	55.55	62.88	69.42	74.74	80.45
Lighting	20.80	24.74	28.01	30.92	33.30	35.83
El. Appliances	14.01	16.66	18.86	20.83	22.42	24.13
Buildings of the private health						
Space Heating	9.28	9.71	10.03	10.36	10.69	11.04
DHW	0.47	0.51	0.54	0.57	0.61	0.64
Cooling	0.46	0.74	0.96	1.19	1.44	1.71
Cooking	0.47	0.49	0.51	0.53	0.54	0.56
Lighting	1.02	1.07	1.11	1.14	1.18	1.22
El. Appliances	0.71	0.74	0.76	0.79	0.81	0.84
Sports and other activities						
Space Heating	2.39	2.51	2.60	2.68	2.77	2.86
DHW	0.07	0.08	0.08	0.09	0.09	0.10
Cooling	0.12	0.19	0.24	0.30	0.36	0.43
Cooking	0.00	0.00	0.00	0.00	0.00	0.00
Lighting	0.28	0.29	0.30	0.31	0.32	0.33
El. Appliances	0.08	0.09	0.09	0.09	0.10	0.10

Source: Calculated by the Consultant

Step 8: Useful energy for each energy service category: 1) Space Heating; 2) Domestic Hot Water (DHW); 3) Space Cooling; 4) Cooking; 5) Lighting; and 6) Electrical Appliances for each public building subcategory is calculated based on final energy (calculated under step 7) multiplied with average efficiencies for group of technical systems (table I-26), used under each building category, under each climatic zone. Average efficiencies for technical systems assumed are based on energy surveys carried out for the public building sub-sector by the AEE and figures used under National Strategy of Energy and NECP.

Table I-26: Average efficiencies for technical systems, for private buildings category, under each climatic zone and for each scenario

Private Buildings Categories	Average Space Heating Efficiency Technical Systems:							Average Water Heating Eff. Tech. Systems	Average Water Heating Eff. Tech.	Average Cooking Eff. Tech. Systems	Average Lighting Eff. Tech. Systems	Average Elec. Appl. Eff. Tech. Systems
	Elect. AC split unit	Elect. Heaters	Diesel	LPG	Wood	Pellet	Agg. Effic.					

									Systems Cooling			
Zone 1												
Wholesale and retail buildings	90.9%	100%	84.00%	85.05%	50.40%	73.78%	87.7%	92.3%	90.9%	80.9%	92.3%	84.1%
Private Offices	90.9%	100%	84.00%	85.05%	50.40%	73.78%	88.3%	92.3%	90.9%	79.8%	92.3%	84.1%
Educational buildings	90.9%	100%	84.00%	85.05%	50.40%	73.78%	91.7%	92.3%	90.9%	89.3%	92.3%	84.1%
Hotels and restaurants	90.9%	100%	84.00%	85.05%	50.40%	73.78%	91.5%	92.3%	90.9%	50.4%	92.3%	84.1%
Health care facilities	90.9%	100%	84.00%	85.05%	50.40%	73.78%	89.6%	92.3%	90.9%	50.4%	92.3%	84.1%
Zone 2												
Wholesale and retail buildings	86.4%	100%	81.90%	82.95%	45.15%	70.83%	81.8%	88.4%	86.4%	85.6%	87.7%	79.9%
Private Offices	86.4%	100%	81.90%	82.95%	45.15%	70.83%	82.4%	88.4%	86.4%	82.3%	87.7%	79.9%
Educational buildings	86.4%	100%	81.90%	82.95%	45.15%	70.83%	86.0%	88.4%	86.4%	83.4%	87.7%	79.9%
Hotels and restaurants	86.4%	100%	81.90%	82.95%	45.15%	70.83%	85.9%	88.4%	86.4%	76.3%	87.7%	79.9%
Health care facilities	86.4%	100%	78.75%	79.80%	45.15%	70.83%	83.4%	88.4%	86.4%	76.1%	87.7%	79.9%
Zone 3												
Wholesale and retail buildings	82.0%	100%	76.39%	79.80%	41.42%	66.58%	76.9%	84.7%	82.0%	83.5%	83.3%	75.9%
Private Offices	82.0%	100%	76.39%	79.80%	41.42%	66.58%	77.4%	84.7%	82.0%	79.9%	83.3%	75.9%
Educational buildings	82.0%	100%	76.39%	79.80%	41.42%	66.58%	80.8%	84.7%	82.0%	81.4%	83.3%	75.9%
Hotels and restaurants	82.0%	100%	76.39%	79.80%	41.42%	66.58%	80.8%	84.7%	82.0%	77.2%	83.3%	75.9%
Health care facilities	82.0%	100%	76.39%	79.80%	41.42%	66.58%	79.2%	84.7%	82.0%	79.4%	83.3%	75.9%

Calculation of useful energy service demand was carried out, for each private building sub-category, for each climatic zone and the respective values are presented at the Table I-27.

Table I-27: Forecast useful energy demand (GWh/year), for each energy service, for each private buildings categories, under each climatic zone and for baseline scenario

Private Buildings sub-sector	2023	2030	2035	2040	2045	2050
ZONE 1						
Wholesale and retail trade						
Space Heating	82.95	89.98	95.34	100.98	106.92	113.15
DHW	30.08	33.80	36.72	39.87	43.29	46.97
Cooling	32.38	39.53	45.26	51.56	58.48	66.05
Cooking	24.61	26.70	28.29	29.96	31.72	33.58
Lighting	33.69	36.55	38.73	41.02	43.43	45.96
El. Appliances	29.24	31.72	33.61	35.60	37.69	39.89
Private office of various professions						
Space Heating	21.79	23.36	24.54	25.77	27.06	28.39
DHW	2.46	2.74	2.95	3.17	3.42	3.68
Cooling	10.50	12.54	14.16	15.93	17.84	19.92
Cooking	4.79	5.14	5.40	5.67	5.95	6.25
Lighting	10.49	11.24	11.81	12.41	13.02	13.67
El. Appliances	8.98	9.63	10.12	10.63	11.16	11.71
Private kindergarten/school/universities						
Space Heating	23.37	25.05	26.32	27.65	29.02	30.46
DHW	5.24	5.82	6.27	6.75	7.27	7.82
Cooling	5.41	6.60	7.54	8.56	9.67	10.88
Cooking	1.27	1.36	1.43	1.50	1.58	1.65
Lighting	6.72	7.20	7.57	7.95	8.34	8.76
El. Appliances	1.79	1.92	2.02	2.12	2.23	2.34
Hotels and restaurants						
Space Heating	226.26	269.21	304.73	336.45	362.26	389.89
DHW	129.00	158.96	184.49	208.85	230.57	254.44
Cooling	52.63	74.86	94.77	115.83	136.90	160.59
Cooking	93.96	111.79	126.54	139.71	150.43	161.91
Lighting	73.98	88.02	99.64	110.00	118.44	127.48
El. Appliances	47.03	55.95	63.33	69.93	75.29	81.03
Buildings of the private health						
Space Heating	17.34	18.16	18.76	19.37	20.00	20.63
DHW	2.04	2.22	2.35	2.49	2.63	2.78
Cooling	4.14	5.00	5.66	6.36	7.11	7.90
Cooking	1.12	1.17	1.21	1.25	1.29	1.33

Lighting	4.29	4.49	4.64	4.79	4.95	5.11
El. Appliances	2.79	2.93	3.02	3.12	3.22	3.32
Sports and other activities						
Space Heating	4.75	4.97	5.13	5.30	5.47	5.65
DHW	0.33	0.36	0.38	0.40	0.42	0.45
Cooling	1.13	1.35	1.51	1.69	1.88	2.08
Cooking	0.00	0.00	0.00	0.00	0.00	0.00
Lighting	1.24	1.29	1.34	1.38	1.42	1.47
El. Appliances	0.35	0.37	0.38	0.39	0.40	0.42
ZONE 2						
Wholesale and retail trade						
Space Heating	30.18	32.75	34.70	36.75	38.91	41.18
DHW	8.08	9.08	9.87	10.72	11.63	12.62
Cooling	6.60	8.50	10.03	11.72	13.58	15.64
Cooking	7.24	7.86	8.33	8.82	9.34	9.88
Lighting	9.02	9.78	10.37	10.98	11.62	12.30
El. Appliances	7.85	8.52	9.02	9.56	10.12	10.71
Private office of various professions						
Space Heating	8.25	8.84	9.29	9.76	10.25	10.75
DHW	0.64	0.72	0.77	0.83	0.89	0.96
Cooling	2.08	2.62	3.05	3.51	4.02	4.58
Cooking	1.35	1.45	1.52	1.60	1.68	1.76
Lighting	2.73	2.93	3.08	3.23	3.39	3.56
El. Appliances	2.33	2.50	2.62	2.76	2.89	3.04
Private kindergarten/school/universities						
Space Heating	7.61	8.16	8.57	9.00	9.45	9.92
DHW	1.49	1.66	1.78	1.92	2.07	2.22
Cooling	0.99	1.30	1.54	1.81	2.11	2.43
Cooking	0.35	0.38	0.40	0.42	0.44	0.46
Lighting	1.90	2.04	2.14	2.25	2.36	2.48
El. Appliances	0.51	0.54	0.57	0.60	0.63	0.66
Hotels and restaurants						
Space Heating	82.25	97.85	110.77	122.29	131.68	141.72
DHW	34.36	42.34	49.14	55.63	61.42	67.78
Cooling	10.89	16.79	22.15	27.96	33.93	40.67
Cooking	39.55	47.06	53.27	58.81	63.32	68.15
Lighting	19.63	23.36	26.44	29.19	31.43	33.83
El. Appliances	12.42	14.78	16.73	18.47	19.88	21.40
Buildings of the private health						
Space Heating	5.91	6.20	6.40	6.61	6.83	7.04
DHW	0.52	0.56	0.59	0.63	0.66	0.70
Cooling	0.79	1.03	1.21	1.41	1.62	1.84
Cooking	0.44	0.47	0.48	0.50	0.51	0.53
Lighting	1.08	1.13	1.17	1.21	1.24	1.28
El. Appliances	0.70	0.73	0.76	0.78	0.81	0.83
Sports and other activities						
Space Heating	1.59	1.66	1.71	1.77	1.83	1.88
DHW	0.08	0.09	0.09	0.10	0.10	0.11
Cooling	0.21	0.27	0.32	0.36	0.42	0.47
Cooking	0.00	0.00	0.00	0.00	0.00	0.00
Lighting	0.31	0.32	0.33	0.34	0.35	0.36
El. Appliances	0.07	0.08	0.08	0.08	0.09	0.09
ZONE 3						
Wholesale and retail trade						
Space Heating	39.95	43.33	45.91	48.63	51.48	54.49
DHW	7.06	7.93	8.61	9.36	10.16	11.02
Cooling	4.45	6.36	7.92	9.65	11.58	13.71
Cooking	5.65	6.13	6.50	6.88	7.29	7.71
Lighting	8.12	8.81	9.33	9.88	10.46	11.07
El. Appliances	6.96	7.55	8.00	8.47	8.97	9.49
Private office of various professions						
Space Heating	12.03	12.89	13.55	14.23	14.94	15.67
DHW	0.54	0.59	0.64	0.69	0.74	0.80
Cooling	1.34	1.86	2.28	2.75	3.26	3.82
Cooking	1.05	1.13	1.19	1.25	1.31	1.37
Lighting	2.34	2.51	2.63	2.77	2.90	3.05
El. Appliances	1.94	2.07	2.18	2.29	2.40	2.52
Private kindergarten/school/universities						
Space Heating	9.37	10.03	10.54	11.07	11.62	12.20

DHW	1.21	1.35	1.45	1.56	1.68	1.81
Cooling	0.49	0.79	1.03	1.29	1.58	1.90
Cooking	0.30	0.32	0.34	0.35	0.37	0.39
Lighting	1.06	1.13	1.19	1.25	1.31	1.38
El. Appliances	0.41	0.44	0.46	0.48	0.51	0.53
Hotels and restaurants						
Space Heating	108.25	128.79	145.78	160.95	173.30	186.52
DHW	29.67	36.56	42.43	48.03	53.02	58.52
Cooling	5.62	10.93	15.85	21.39	27.27	33.97
Cooking	37.29	44.36	50.22	55.44	59.70	64.25
Lighting	17.32	20.60	23.32	25.75	27.72	29.84
El. Appliances	10.63	12.65	14.31	15.80	17.02	18.31
Buildings of the private health						
Space Heating	7.50	7.85	8.11	8.37	8.64	8.92
DHW	0.40	0.43	0.46	0.49	0.51	0.54
Cooling	0.38	0.61	0.79	0.98	1.18	1.40
Cooking	0.38	0.40	0.41	0.43	0.44	0.46
Lighting	0.85	0.89	0.92	0.95	0.98	1.01
El. Appliances	0.54	0.56	0.58	0.60	0.62	0.64
Sports and other activities						
Space Heating	1.93	2.03	2.10	2.17	2.24	2.31
DHW	0.06	0.07	0.07	0.07	0.08	0.08
Cooling	0.10	0.15	0.20	0.24	0.30	0.35
Cooking	0.00	0.00	0.00	0.00	0.00	0.00
Lighting	0.23	0.24	0.25	0.26	0.27	0.28
El. Appliances	0.06	0.07	0.07	0.07	0.07	0.08

Source: Calculated by the Consultant

Main conclusion of final and useful energy demand for the private buildings sub-sector are as following:

- Total final energy demand, for private buildings, is increased from 1,968.74 GWh (2023) to 3,379.47 GWh (2050) for baseline scenario (BLS) (figure I-49). Meanwhile, total useful energy demand is 2,811.84 GWh (2050) for BLS (figure I-50).
- Total final space heating energy demand, for private buildings, is increased from 807.09 GWh (2023) to 1,260.62 GWh (2050) for BLS (figure I-51). Meanwhile, total useful space heating energy demand is 1,080.77 GWh (2050) for BLS (figure I-52).
- Total final space cooling energy demand, for private buildings, is increased from 156.26 GWh (2023) to 435.25 GWh (2050) for BLS (figure I-53). Meanwhile, total useful space cooling energy demand is 388.20 GWh (2050) for BLS (figure I-54).
- Total final water heating energy demand, for private buildings, is increased from 280.04 GWh (2023) to 523.43 GWh (2050) for BLS (figure I-55). Meanwhile, total useful water heating energy demand is 473.32 GWh (2050) for BLS (figure I-56).

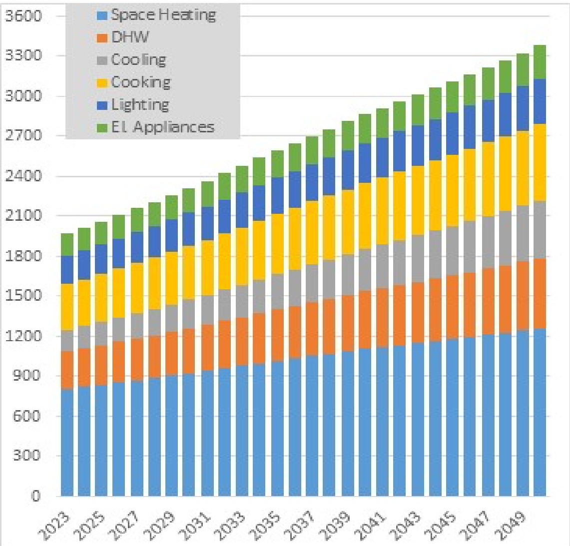


Figure I-49: Private Buildings Final Energy Services forecast for BL Scenario, in GWh

Source: Calculated by the Consultant

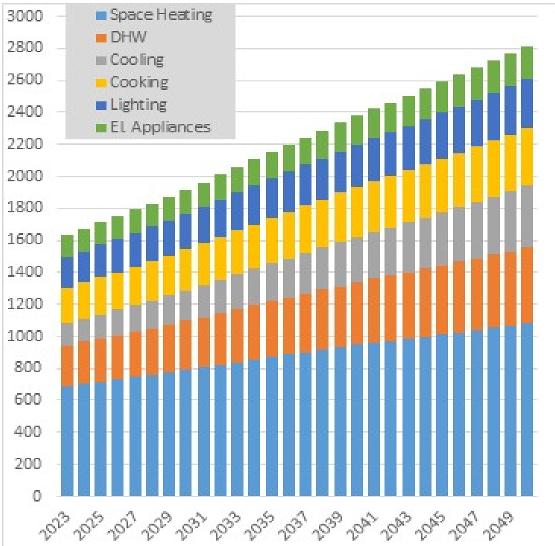


Figure I-50: Private Buildings Useful Energy Services forecast for BLS, in GWh

Source: Calculated by the Consultant

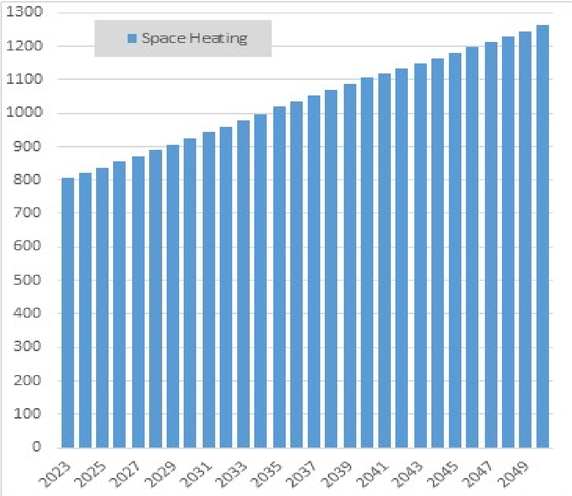


Figure I-51: Private Buildings Final Energy Heating forecast for BL Scenario, in GWh

Source: Calculated by the Consultant

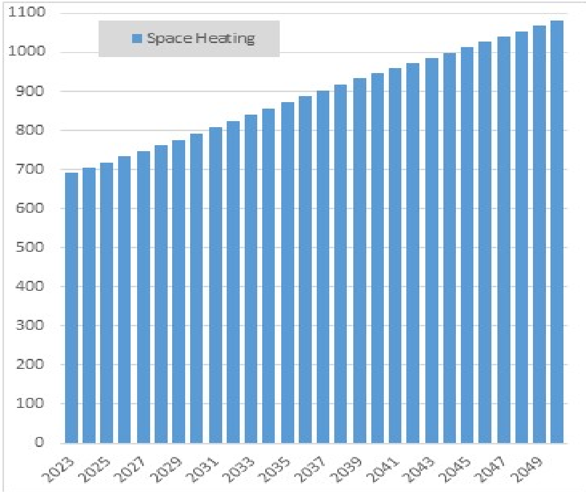


Figure I-52: Private Buildings Useful Space Heating forecast for BL Scenario, in GWh

Source: Calculated by the Consultant

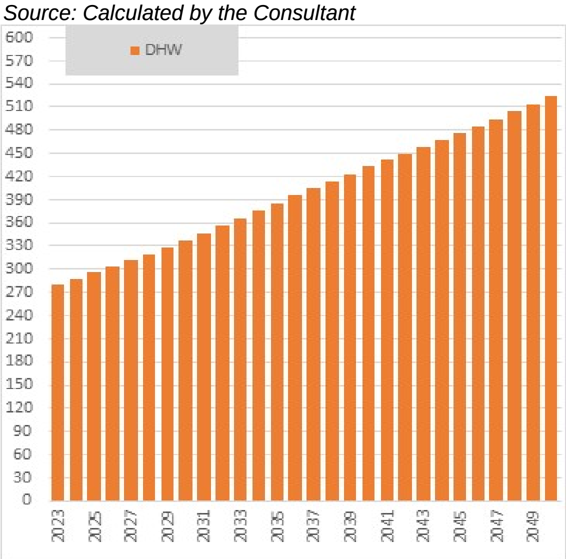


Figure I-53: Private Buildings Final Energy Cooling forecast for BL Scenario, in GWh

Source: Calculated by the Consultant

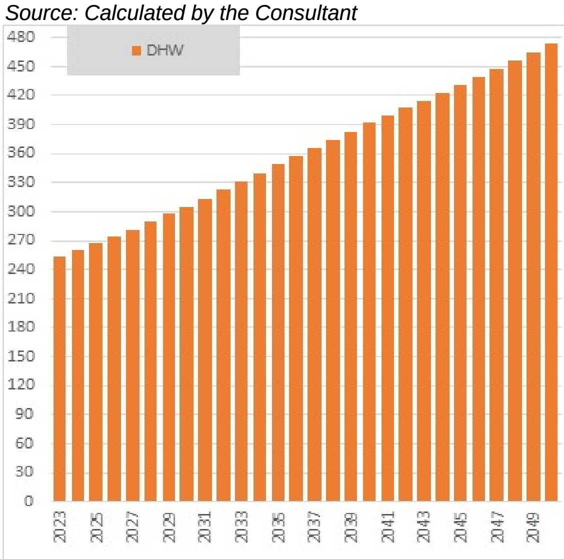


Figure I-54: Private Buildings Useful Space Cooling forecast for BL Scenario, in GWh

Source: Calculated by the Consultant

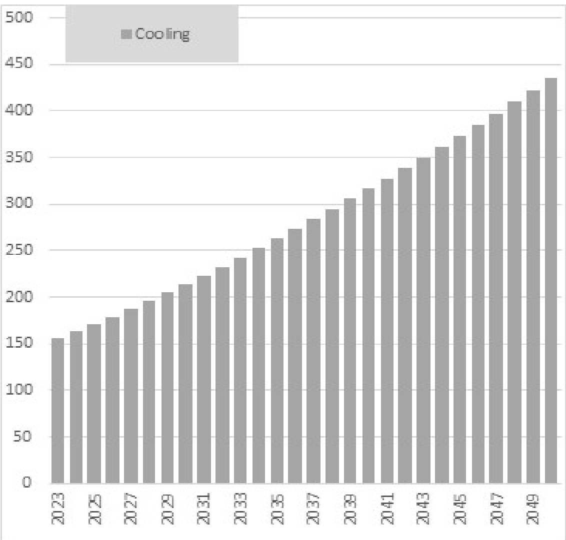


Figure I-55: Private Buildings Final Energy Water Heating forecast for BL Scenario, GWh

Source: Calculated by the Consultant

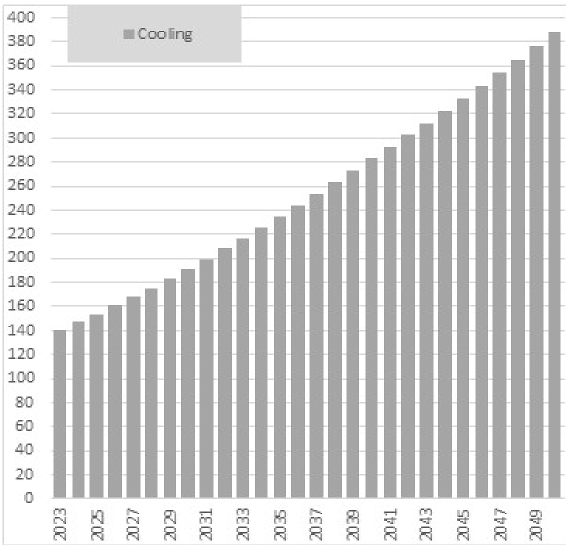


Figure I-56: Private Buildings Useful Water Heating forecast for BL Scenario, in GWh

Source: Calculated by the Consultant

I.2.4 Industry Sector

Industrial enterprises use energy commodities for heating for own use, for non-energy purposes, transport, electricity production and heat production for sale. Fuels used for the last three categories are not part of energy consumption by final users and are usually reported elsewhere in a questionnaire. Fuels used for transport by enterprises are reported in the transport sector in final consumption. The Industry Sector in the National Energy Strategy is divided into several industrial subsectors: Metallurgical Industry; Chemical; Construction Materials; Mining; Food/Beverages/Tobacco; Textiles/Leather/Footwear; Wood/Paper/Printing; Mechanical. The analysis of economic development for the years 2010-2023 shows that, during the transition period, the role and weight of the Industry Sector has suffered a decrease in terms of contribution to national economic development. But at the same time, it is noted that after the political and social transformations, the changes in ownership and management of industrial enterprises, a tendency towards stabilization in a new situation, imposed by the introduction of the market economy, is also being observed. Figure I-57 schematically presents all the factors that participate in determining the values of energy consumption for the current and future situation for the industrial sector and it is worth emphasizing that the values set in the 4.49 are for illustrative purposes only.

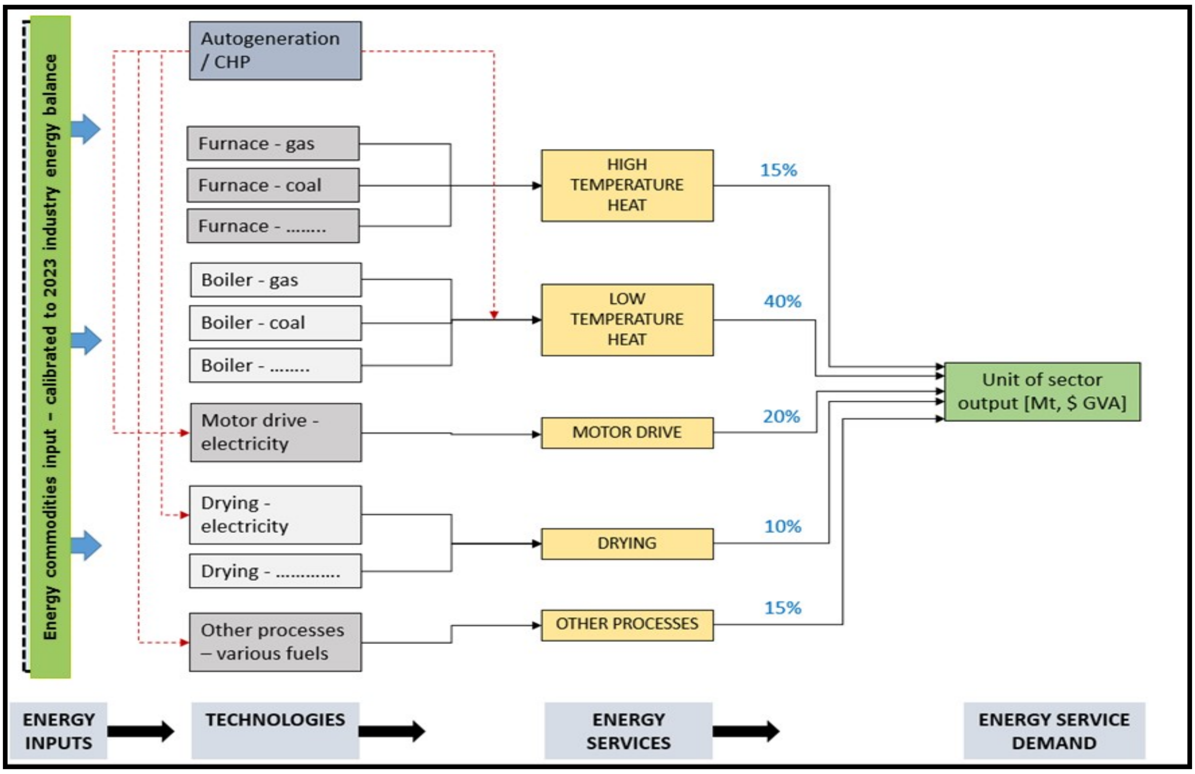


Figure I-57: Factors that participate in determining the energy consumption values for the industrial sector

Source: Prepared by the consultant team

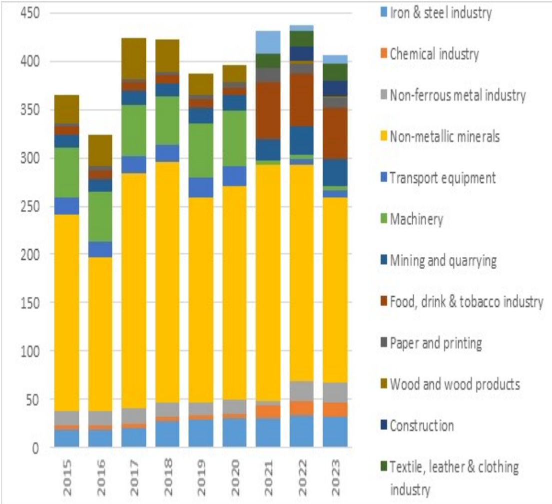


Figure I-58: Trend of final energy consumption for industrial subsectors for the years 2015-2023 (ktoe)

Source: Calculations performed by EECG consultants based on the Albanian Energy Balance 2015-2023, INSTAT, MIE/AKBN

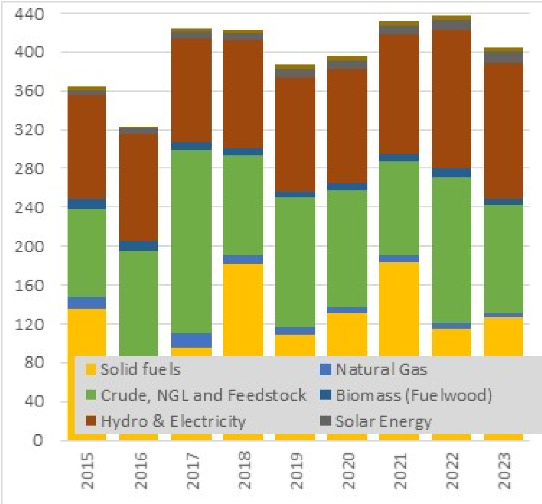


Figure I-59: Trend of final energy consumption according to the energy commodities for the years 2015-2023 (ktoe)

Source: Calculations performed by EECG consultants based on the Albanian Energy Balance 2015-2023, INSTAT, MIE/AKBN

It should also be noted that in the last 10 years, the stabilizing developments and growth trends in the manufacturing industry have been based mainly on existing technologies, without excluding any positive developments. From the perspective of energy consumers, the industry continues to have a very high energy intensity for each unit of production in kind 0.1 toe/ton and for each monetary unit produced 0.8 toe/thousand USD (i.e. to produce 1000 USD in value of industrial products 200 USD will be the only energy cost item. Figures I-60 – I-61 present the performance of final energy consumption for each of the industrial sub-sectors for the period 2015 – 2023 (ktoe) prepared by EECG experts based on the country's energy balances. The analysis of the graphs shows that in 2023 a slight decrease in energy consumption in the industrial sector is observed versur 2022. Main reason for this reduction is post Covid-2019 industrial sector and increase of the energy efficiency due to very high price face for for oil by products. The main share of energy sources is held by oil by-products, electricity and coal. The subsectors with the highest energy consumption are the producers of non-metallic materials (construction materials, bricks, asphalt, cement, etc.), the non-ferrous materials industry (chrome mining and processing industry), the food industry and the metallurgical industry.

It is important to be mentioned that industrial costumers are using only Boiler Heating Only scheme for low to medium temperature and for high temperature are used industrial furnance. Cooling chambers are used frequently for securing space cooling for the industrial processes and AC split units are used for securing comfort conditions for administrations and working force. Actually, there are no DH scheme for industrial costumers in Albania. At the same time it is important to be mentioned that DH scheme existed in many ex-socialist industrial enterprises and nowdays all of them are demolished since 1995. Albanian Goverment has approved natural gas penetration plan since 2016 and the first project to be implemented is gasification of Korca city based on NUR-Project financed 70% from Goverment and 30% from Socar (National Azerbaijan Oil & Gas Company). According to MIE website information this project is in te feasibility study stage and it is planned to be finalised by the end of 2027.

EECG team used excel spreadsheet model based on the same LEAP methodology taking into consideration base year energy consumption, share of fuels, energy intensity and value added as main economic driver for calculating the demand up to 2050. The main factors for calculating space heating and cooling energy demand for the industrial sub-sectors is the GDP increase from each sub-sector, share of different fuels, penetration of the space heating and cooling energy service as well as the energy intensity of each energy commodity based on the data used in the Strategy of Energy for the Industrial Sector. In order to calculate the space heating and cooling energy demand, the Consultant carried out the breakdown calculation on three important energy services: 1) Low temperature process heating & cooling; 2) High temperature process heating (and deep cooling), and 3) Motive power. Energy consumption and forecasted demand for all industrial sub-sectors was carefully analyzed and calculated for each sub-industrial sector since they are consuming very high amounts of electricity, heavy fuel oil, diesel, and firewood. Space heating and cooling energy demand are calculated based on following the eight steps described below:

Step 1: The main factors for calculating electricity energy demand for the industrial sub-sectors were the GDP increase, share of different fuels, intensity of each energy commodity based on the data used in the Strategy of Energy, NECP, energy audits in different industrial sectors and assumption used by the consultant for the Industrial Sector. Based on the reports of the Bank of Albania, the World Bank and EBRD, the real trend of the economic development of Albania is expressed by the GDP-industrial sub-sectors contribution for the period 2015-2023 is shown at **Error! Reference source not found.**-4.53. Analysis shows almost 10-12% industrial reduction on 2021-22 due to Covid-19 and good recovery for the year 2023.

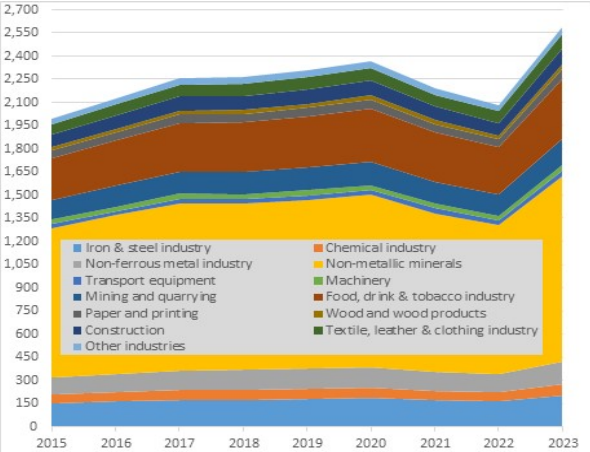


Figure I-60: Growth of GDP in real terms for sub-industrial sectors, for the years 2015-2023, in MEuro

Source: Prepared by the Consultant based on INSTAT and extrapolation method for each sub-industrial sector

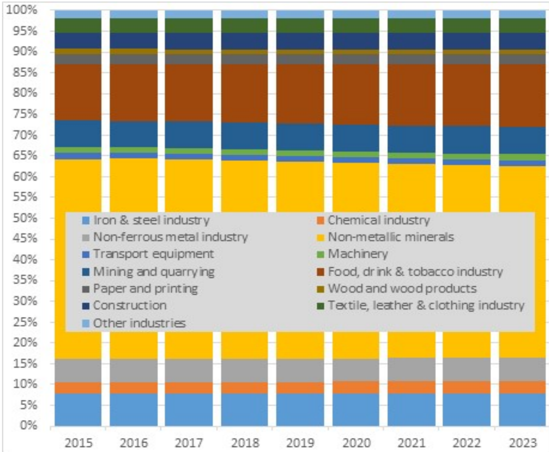


Figure I-61: Shares of GDP in real terms for sub-industrial sectors, for the years 2015-2023, in %

Source: Prepared by the Consultant based on INSTAT and extrapolation method for each sub-industrial sector

Step 2: GDP sub-industrial sectors forecast is based on the National Strategy of Energy and calibrated with the latest values of NECP and the results are presented at figures I-62 – I-63.

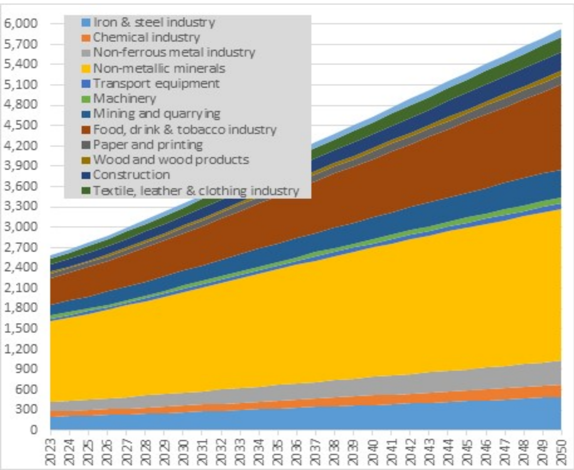


Figure I-62: Growth of GDP in real terms for sub-industrial sectors, for the years 2023-2050, in MEuro

Source: Prepared by the Consultant based on NSE and NECP for each sub-industrial sector

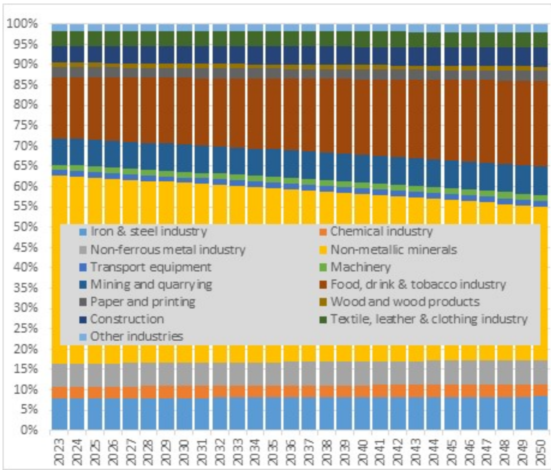


Figure I-63: Shares of GDP in real terms for sub-industrial sectors, for the years 2023-2050, in %

Source: Prepared by the Consultant based on NSE and NECP for each sub-industrial sector

Step 3: Breakdown of total industrial energy consumption into 13 sub-industrial sectors for above mentioned sub-industrial sectors (first column), for each energy commodity, for baseline scenario. Values of Energy Commodities for each sub-industrial sector for 2023 are based on the figures of the Yearly Energy Balance. Shares of Energy Commodities for each sub-industrial sector for 2023 are based on the figures of the Yearly Energy Balance and are calculated by the consultant and expressed in %. Forecasted of share of the energy commodities, for each sub-industrial sector, for baseline scenario are based on the assumptions undertaken under the Strategy of Energy and revised document of NECP. All respective figures and assumptions are presented at Table I-28.

Table I-28: Breakdown of total industrial energy commodities on 13-sub-industrial sectors

Energy Commodities (EC)	**Values of EC for 2023, GWh**	**Shares of EC for 2023, %**	**Forecasted of EC for BLS for 2050, %**	**Values of EC for 2023, GWh**	**Shares of EC for 2023, %**	**Forecasted of EC for BLS for 2050, %**
Iron & steel industry				Food, drink & tobacco industry		
Solid fuels	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Natural Gas	0.00	0.00%	0.00%	48.71	8.03%	9.70%
Oil by Products	32.53	8.88%	10.72%	203.23	33.52%	40.46%
Fuelwood	0.00	0.00%	0.00%	48.41	7.98%	9.64%
Electricity	333.89	91.12%	89.28%	241.82	39.88%	27.42%
Solar Energy	0.00	0.00%	0.00%	9.53	1.57%	1.90%
Derived Heat	0.00	0.00%	0.00%	54.65	9.01%	10.88%
Chemical industry				Paper and printing		
Solid fuels	36.63	20.72%	25.02%	0.00	0.00%	0.00%
Natural Gas	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Oil by Products	4.53	2.56%	3.09%	31.88	27.24%	32.89%
Fuelwood	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Electricity	135.61	76.72%	71.89%	74.67	63.81%	56.32%
Solar Energy	0.00	0.00%	0.00%	10.47	8.94%	10.80%
Derived Heat	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Non-ferrous metal industry				Wood and wood products		
Solid fuels	36.63	15.68%	18.93%	0.00	0.00%	0.00%
Natural Gas	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Oil by Products	4.53	1.94%	2.34%	0.00	0.00%	0.00%
Fuelwood	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Electricity	192.37	82.38%	78.72%	11.76	35.98%	22.71%
Solar Energy	0.00	0.00%	0.00%	20.93	64.02%	77.29%
Derived Heat	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Non-metallic minerals				Construction		
Solid fuels	1443.29	64.40%	56.25%	0.00	0.00%	0.00%
Natural Gas	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Oil by Products	607.31	27.10%	24.99%	44.78	24.58%	29.68%
Fuelwood	28.34	1.26%	1.53%	0.00	0.00%	0.00%
Electricity	133.07	5.94%	15.67%	137.38	75.42%	70.32%
Solar Energy	29.07	1.30%	1.57%	0.00	0.00%	0.00%
Derived Heat	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Transport equipment				Textile, leather & clothing industry		
Solid fuels	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Natural Gas	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Oil by Products	0.00	0.00%	0.00%	36.48	18.66%	22.53%
Fuelwood	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Electricity	66.89	94.26%	92.79%	147.36	75.39%	70.29%
Solar Energy	4.07	5.74%	7.21%	11.63	5.95%	7.18%
Derived Heat	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Machinery				Other industries		
Solid fuels	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Natural Gas	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Oil by Products	0.00	0.00%	0.00%	102.69	100.00%	80.50%
Fuelwood	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Electricity	52.21	100.00%	100.00%	0.00	0.00%	19.50%
Solar Energy	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Derived Heat	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Mining and quarrying						
Solid fuels	0.00	0.00%	0.00%			
Natural Gas	0.00	0.00%	0.00%			
Oil by Products	118.45	35.04%	42.30%			
Fuelwood	0.00	0.00%	0.00%			
Electricity	211.60	62.59%	54.84%			
Solar Energy	8.02	2.37%	2.87%			
Derived Heat	0.00	0.00%	0.00%			

Source: Calculated by the Consultant

Step 4: Breakdown of the respective energy services: 1) low temperature process heating (LTPH); 2) high temperature process heating (HTPH); 3) motive power (MP) and 4) cooling (including space cooling for office and workshops as well as cooling for industrial processes) are presented for baseline scenario. Breakdown for above mentioned energy services was based on the Strategy of Energy and on the bench mark values based on different studies. The respective shares of the energy service for year 2023 as well 2050 are presented at the Table I-29.

Table I-29: Breakdown of the energy services: 1) low temperature process heating (LTPH); 2) high temperature process heating (HTPH); 3) motive power (MP) and 4) cooling

Energy Services (ES)	Values of ES for 2023, GWh	Shares of ES for 2023, %	Forecasted of EC for BLS for 2050, %	Values of ES for 2023, GWh	Shares of ES for 2023, %	Forecasted of EC for BLS for 2050, %
Iron & steel industry				Food, drink & tobacco industry		
High Temperature energy	245.11	66.89%	61.68%	103.38	17.05%	15.72%
Low Temperature energy	21.15	5.77%	6.09%	305.15	50.32%	53.11%
Cooling	4.01	1.09%	1.09%	51.44	8.48%	8.10%
Mechanical/motive energy	96.16	26.24%	26.24%	146.40	24.14%	23.06%
Chemical industry				Paper and printing		
High Temperature energy	132.46	74.93%	70.99%	63.42	54.20%	49.98%
Low Temperature energy	3.63	2.05%	2.22%	15.25	13.03%	13.75%
Cooling	7.32	4.14%	3.88%	1.53	1.31%	1.33%
Mechanical/motive energy	33.36	18.87%	26.78%	36.80	31.45%	36.27%
Non-ferrous metal industry				Wood and wood products		
High Temperature energy	172.42	73.83%	68.08%	1.18	3.60%	3.32%
Low Temperature energy	3.40	1.46%	1.54%	20.93	64.02%	67.57%
Cooling	2.31	0.99%	0.94%	0.53	1.62%	1.02%
Mechanical/motive energy	55.40	23.72%	30.38%	10.06	30.76%	19.41%
Non-metallic minerals				Construction		
High Temperature energy	1748.99	78.04%	71.96%	0.00	0.00%	0.00%
Low Temperature energy	452.16	20.18%	21.29%	0.00	0.00%	0.00%
Cooling	1.60	0.07%	0.19%	1.82	1.00%	1.00%
Mechanical/motive energy	38.32	1.71%	6.74%	180.34	99.00%	99.00%
Transport equipment				Textile, leather & clothing industry		
High Temperature energy	46.82	65.99%	60.84%	9.19	4.70%	4.34%
Low Temperature energy	4.07	5.74%	6.05%	20.75	10.61%	11.20%
Cooling	0.60	0.85%	0.84%	1.66	0.85%	0.84%
Mechanical/motive energy	19.46	27.43%	27.43%	163.87	83.84%	83.62%
Machinery				Other industries		
High Temperature energy	20.88	40.00%	36.88%	5.13	5.00%	4.61%
Low Temperature energy	0.00	0.00%	0.00%	15.40	15.00%	15.83%
Cooling	0.94	1.80%	1.80%	3.29	3.20%	3.18%
Mechanical/motive energy	30.39	58.20%	58.20%	78.87	76.80%	76.38%
Mining and quarrying						
High Temperature energy	*60.09*	*17.77%*	*16.39%*			
Low Temperature energy	*79.95*	*23.65%*	*24.96%*			
Cooling	*5.94*	*1.76%*	*1.76%*			
Mechanical/motive energy	*192.08*	*56.82%*	*56.89%*			

Source: Calculated by the Consultant

Step 5: Forecast of electricity demand for industrial subsectors up to 2050, based on the energy intensities for all energy commodities according to the energy strategy for the period 2023-2050 for each sub-industrial sector. The respective energy intensity values for each energy services for year 2023 are presented at the last column of the Table I-30.

Table I-30: Actual and forecasted energy intensity for 13-sub-industrial sectors (kWh/Euro)

Sub-industrial sector	2023	2030	2035	2040	2045	2050
Iron & steel industry	1.799	1.706	1.639	1.573	1.506	1.440
Chemical industry	2.372	2.249	2.161	2.073	1.985	1.898
Non-ferrous metal industry	1.595	1.512	1.453	1.394	1.335	1.276
Non-metallic minerals	1.874	1.777	1.707	1.638	1.569	1.499
Transport equipment	2.016	1.912	1.837	1.762	1.688	1.613
Machinery	1.462	1.386	1.332	1.278	1.224	1.170
Mining and quarrying	2.004	1.900	1.826	1.752	1.677	1.603
Food, drink & tobacco industry	1.558	1.477	1.420	1.362	1.304	1.246
Paper and printing	1.846	1.750	1.682	1.613	1.545	1.477
Wood and wood products	1.149	1.089	1.046	1.004	0.961	0.919
Construction	1.738	1.648	1.584	1.519	1.455	1.391
Textile, leather & clothing industry	2.110	2.001	1.923	1.844	1.766	1.688
Other industries	2.100	1.991	1.913	1.835	1.758	1.680

Source: Calculated by the Consultant

Step 6: Carry out the Final Energy Demand Forecast, for each energy commodity, for each industrial sub-sector based on the formula:

EnergyComm.$_{demand}$ = activity level x share of energy commodity x energy intensity for each industrial sub-sector.

Calculation of final energy demand was carried out based on the entire data mentioned on all steps above for each industrial sub-sector, each energy commodity and the respective values are presented at the Table I-31.

Table I-31: Forecast final energy demand (GWh/year), for each industrial sub-sector, for each energy commodity for baseline scenario

Energy Commodities (EC)	2023	2030	2035	2040	2045	2050
Iron & steel industry						
Solid fuels	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00
Oil by Products	32.53	42.56	50.97	59.39	67.73	75.96
Fuelwood	0.00	0.00	0.00	0.00	0.00	0.00
Electricity	333.89	413.97	477.04	534.70	586.64	632.72
Solar Energy	0.00	0.00	0.00	0.00	0.00	0.00
Derived Heat	0.00	0.00	0.00	0.00	0.00	0.00
Chemical industry						
Solid fuels	36.63	47.92	57.39	66.86	76.26	85.52
Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00
Oil by Products	4.53	5.93	7.10	8.27	9.43	10.58
Fuelwood	0.00	0.00	0.00	0.00	0.00	0.00
Electricity	135.61	166.39	190.23	211.46	229.98	245.77
Solar Energy	0.00	0.00	0.00	0.00	0.00	0.00
Derived Heat	0.00	0.00	0.00	0.00	0.00	0.00
Non-ferrous metal industry						
Solid fuels	36.63	47.92	57.39	66.86	76.26	85.52
Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00
Oil by Products	4.53	5.93	7.10	8.27	9.43	10.58
Fuelwood	0.00	0.00	0.00	0.00	0.00	0.00
Electricity	192.37	237.12	272.03	303.50	331.36	355.56
Solar Energy	0.00	0.00	0.00	0.00	0.00	0.00
Derived Heat	0.00	0.00	0.00	0.00	0.00	0.00
Non-metallic minerals						
Solid fuels	1443.29	1638.70	1767.95	1849.88	1888.33	1887.68
Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00
Oil by Products	607.31	699.30	762.06	805.42	830.46	838.55
Fuelwood	28.34	34.99	40.08	44.53	48.26	51.23
Electricity	133.07	226.48	304.17	382.39	457.38	525.88
Solar Energy	29.07	35.89	41.12	45.68	49.51	52.55
Derived Heat	0.00	0.00	0.00	0.00	0.00	0.00
Transport equipment						
Solid fuels	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00
Oil by Products	0.00	0.00	0.00	0.00	0.00	0.00
Fuelwood	0.00	0.00	0.00	0.00	0.00	0.00
Electricity	66.89	82.74	95.18	106.52	116.67	125.64
Solar Energy	4.07	5.36	6.45	7.56	8.66	9.76
Derived Heat	0.00	0.00	0.00	0.00	0.00	0.00
Machinery						
Solid fuels	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00
Oil by Products	0.00	0.00	0.00	0.00	0.00	0.00
Fuelwood	0.00	0.00	0.00	0.00	0.00	0.00
Electricity	52.21	65.05	75.23	84.65	93.24	100.98
Solar Energy	0.00	0.00	0.00	0.00	0.00	0.00
Derived Heat	0.00	0.00	0.00	0.00	0.00	0.00
Mining and quarrying						
Solid fuels	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00
Oil by Products	118.45	156.04	187.82	219.91	252.08	284.11
Fuelwood	0.00	0.00	0.00	0.00	0.00	0.00
Electricity	211.60	257.54	292.48	322.67	347.97	368.34
Solar Energy	8.02	10.57	12.72	14.90	17.08	19.24
Derived Heat	0.00	0.00	0.00	0.00	0.00	0.00
Food, drink & tobacco industry						
Solid fuels	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	48.71	68.56	86.50	106.17	127.57	150.72
Oil by Products	203.23	286.01	360.85	442.91	532.21	628.77
Fuelwood	48.41	68.12	85.95	105.50	126.77	149.77
Electricity	241.82	299.65	342.93	379.25	407.37	426.12
Solar Energy	9.53	13.42	16.93	20.78	24.97	29.50
Derived Heat	54.65	76.91	97.04	119.11	143.12	169.08
Paper and printing						
Solid fuels	0.00	0.00	0.00	0.00	0.00	0.00

Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00
Oil by Products	31.88	40.84	48.18	55.29	62.13	68.64
Fuelwood	0.00	0.00	0.00	0.00	0.00	0.00
Electricity	74.67	88.51	98.66	106.83	113.09	117.53
Solar Energy	10.47	13.41	15.82	18.15	20.40	22.53
Derived Heat	0.00	0.00	0.00	0.00	0.00	0.00
Wood and wood products						
Solid fuels	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00
Oil by Products	0.00	0.00	0.00	0.00	0.00	0.00
Fuelwood	0.00	0.00	0.00	0.00	0.00	0.00
Electricity	11.76	13.07	13.81	14.06	13.86	13.24
Solar Energy	20.93	26.81	31.63	36.31	40.80	45.07
Derived Heat	0.00	0.00	0.00	0.00	0.00	0.00
Construction						
Solid fuels	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00
Oil by Products	44.78	60.25	73.60	87.48	101.78	116.44
Fuelwood	0.00	0.00	0.00	0.00	0.00	0.00
Electricity	137.38	173.13	201.75	228.56	253.33	275.89
Solar Energy	0.00	0.00	0.00	0.00	0.00	0.00
Derived Heat	0.00	0.00	0.00	0.00	0.00	0.00
Textile, leather & clothing industry						
Solid fuels	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00
Oil by Products	36.48	47.72	57.15	66.58	75.94	85.17
Fuelwood	0.00	0.00	0.00	0.00	0.00	0.00
Electricity	147.36	180.60	206.29	229.10	248.92	265.72
Solar Energy	11.63	15.21	18.22	21.23	24.21	27.15
Derived Heat	0.00	0.00	0.00	0.00	0.00	0.00
Other industries						
Solid fuels	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00
Oil by Products	102.69	120.11	132.78	142.80	150.35	155.64
Fuelwood	0.00	0.00	0.00	0.00	0.00	0.00
Electricity	0.00	6.95	13.44	20.89	29.06	37.69
Solar Energy	0.00	0.00	0.00	0.00	0.00	0.00
Derived Heat	0.00	0.00	0.00	0.00	0.00	0.00

Source: Calculated by the Consultant

Step 7: Carry out the Final Energy Demand Forecast for sub-industrial subsector, for each of the following energy service category: 1) low temperature process heating (LTPH); 2) high temperature process heating (HTPH); 3) motive power (MP) and 4) cooling (including space cooling for office and workshops as well as cooling for industrial processes) based on the formula:

> EnergyService.$_{demand}$ = activity level x share of energy service x energy intensity for each sub-industrial subsector.

Calculation of final energy service demand was carried out based on the entire data mentioned on all steps above for each sub-industrial subsector, for each energy service and the respective values are presented at the Table I-32.

Table I-32: Forecast final energy demand (GWh/year), for each sub-industrial subsector for baseline scenario

Energy Services (ES)	2023	2030	2035	*2040*	2045	2050
Iron & steel industry						
High Temperature energy	*245.11*	*299.03*	*340.69*	*377.61*	*409.73*	*437.12*
Low Temperature energy	*21.15*	*26.72*	*31.21*	*35.47*	*39.46*	*43.16*
Cooling	*4.01*	*5.23*	*6.24*	*7.24*	*8.21*	*9.14*
Mechanical/motive energy	*96.16*	*125.55*	*149.86*	*173.77*	*196.98*	*219.26*
Chemical industry						
High Temperature energy	*132.46*	*165.58*	*191.97*	*216.54*	*239.13*	*259.68*
Low Temperature energy	*3.63*	*4.74*	*5.68*	*6.62*	*7.55*	*8.46*
Cooling	*7.32*	*8.98*	*10.27*	*11.42*	*12.42*	*13.27*
Mechanical/motive energy	*33.36*	*40.93*	*46.80*	*52.02*	*56.58*	*60.46*
Non-ferrous metal industry						
High Temperature energy	*172.42*	*210.35*	*239.66*	*265.63*	*288.22*	*307.49*
Low Temperature energy	*3.40*	*4.29*	*5.02*	*5.70*	*6.34*	*6.94*
Cooling	*2.31*	*2.85*	*3.26*	*3.64*	*3.98*	*4.27*
Mechanical/motive energy	*55.40*	*73.26*	*88.17*	*103.01*	*117.59*	*131.75*

Non-metallic minerals						
High Temperature energy	*1748.99*	*2013.91*	*2194.67*	*2319.54*	*2391.65*	*2414.96*
Low Temperature energy	*452.16*	*539.20*	*602.48*	*652.89*	*690.23*	*714.61*
Cooling	*1.60*	*2.72*	*3.65*	*4.59*	*5.49*	*6.31*
Mechanical/motive energy	*38.32*	*65.23*	*87.60*	*110.13*	*131.73*	*151.45*
Transport equipment						
High Temperature energy	*46.82*	*56.92*	*64.69*	*71.52*	*77.41*	*82.38*
Low Temperature energy	*4.07*	*5.12*	*5.97*	*6.77*	*7.51*	*8.20*
Cooling	*0.60*	*0.74*	*0.86*	*0.96*	*1.05*	*1.13*
Mechanical/motive energy	*19.46*	*25.27*	*30.05*	*34.71*	*39.20*	*43.48*
Machinery						
High Temperature energy	*20.88*	*25.48*	*29.03*	*32.17*	*34.91*	*37.24*
Low Temperature energy	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Cooling	*0.94*	*1.17*	*1.35*	*1.52*	*1.68*	*1.82*
Mechanical/motive energy	*30.39*	*38.38*	*44.82*	*50.90*	*56.58*	*61.82*
Mining and quarrying						
High Temperature energy	*60.09*	*73.82*	*84.52*	*94.15*	*102.67*	*110.08*
Low Temperature energy	*79.95*	*101.73*	*119.43*	*136.40*	*152.51*	*167.66*
Cooling	*5.94*	*7.46*	*8.67*	*9.81*	*10.86*	*11.82*
Mechanical/motive energy	*192.08*	*241.15*	*280.39*	*317.12*	*351.09*	*382.13*
Food, drink & tobacco industry						
High Temperature energy	*103.38*	*135.67*	*162.84*	*190.15*	*217.36*	*244.30*
Low Temperature energy	*305.15*	*414.73*	*510.41*	*611.07*	*716.22*	*825.37*
Cooling	*51.44*	*68.19*	*82.41*	*96.85*	*111.39*	*125.92*
Mechanical/motive energy	*146.40*	*194.08*	*234.54*	*275.64*	*317.03*	*358.38*
Paper and printing						
High Temperature energy	*63.42*	*76.25*	*85.92*	*94.14*	*100.91*	*106.30*
Low Temperature energy	*15.25*	*19.53*	*23.04*	*26.45*	*29.72*	*32.83*
Cooling	*1.53*	*1.88*	*2.15*	*2.39*	*2.60*	*2.78*
Mechanical/motive energy	*36.80*	*45.09*	*51.54*	*57.31*	*62.39*	*66.80*
Wood and wood products						
High Temperature energy	*1.18*	*1.31*	*1.38*	*1.41*	*1.39*	*1.32*
Low Temperature energy	*20.93*	*26.81*	*31.63*	*36.31*	*40.80*	*45.07*
Cooling	*0.53*	*0.59*	*0.62*	*0.63*	*0.62*	*0.60*
Mechanical/motive energy	*10.06*	*11.18*	*11.81*	*12.02*	*11.85*	*11.32*
Construction						
High Temperature energy	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Low Temperature energy	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Cooling	*1.82*	*2.33*	*2.75*	*3.16*	*3.55*	*3.92*
Mechanical/motive energy	*180.34*	*231.05*	*272.60*	*312.88*	*351.57*	*388.40*
Textile, leather & clothing industry						
High Temperature energy	*9.19*	*11.21*	*12.78*	*14.16*	*15.37*	*16.39*
Low Temperature energy	*20.75*	*26.21*	*30.62*	*34.80*	*38.72*	*42.35*
Cooling	*1.66*	*2.06*	*2.38*	*2.68*	*2.95*	*3.19*
Mechanical/motive energy	*163.87*	*204.05*	*235.88*	*265.27*	*292.04*	*316.11*
Other industries						
High Temperature energy	*5.13*	*6.22*	*7.05*	*7.78*	*8.40*	*8.91*
Low Temperature energy	*15.40*	*19.33*	*22.46*	*25.40*	*28.12*	*30.61*
Cooling	*3.29*	*4.06*	*4.67*	*5.22*	*5.72*	*6.15*
Mechanical/motive energy	*78.87*	*97.45*	*112.03*	*125.30*	*137.18*	*147.66*

Source: Calculated by the Consultant

Step 8: Useful energy for each sub-industrial sector: 1) low temperature process heating (LTPH); 2) high temperature process heating (HTPH); 3) motive power (MP) and 4) cooling (part of the motive power) is calculated based on final energy (calculated under step 7) multiplied with average efficiencies for group of technical systems (table I-33). Average efficiencies for technical systems assumed are based on energy surveys carried out for the sub-industrial sub-sector by the AEE and figures used under National Strategy of Energy and NECP.

Table I-33: Average actual efficiencies for technical systems, for sub-industrial sector

Sub-sector	Solid fuels	Natural Gas	Diesel	Electricity	**Weighted Av. High Temperature Heat Energy**	Fuelwood	Solar Energy	Derived Heat	Electricity	**Weighted Av. Low Temperature Heat Energy**	**Motive power**
Iron & steel industry			65%	82%	**75.57%**				84.05%	**84.05%**	**90.9%**
Chemical industry			67%	85%	**68.82%**				87.13%	**87.13%**	**90.9%**
Non-ferrous metal industry	60%		65%	83%	**70.16%**				85.08%	**85.08%**	**90.9%**
Non-metallic minerals	62.5%		62%	85%	**62.58%**	50%	85%		87.13%	**74.08%**	**90.9%**

Transport equipment			68%	85%	**85.00%**		85%		87.13%	**86.65%**	**90.9%**
Machinery			68%	85%	**85.00%**				87.13%	**87.13%**	**90.9%**
Mining and quarrying			62%	85%	**67.11%**		85%		87.13%	**86.80%**	**90.9%**
Food, drink & tobacco industry		68%	70%	88%	**72.06%**	55%	85%	80%	90.20%	**76.05%**	**86.4%**
Paper and printing			68%	84%	**72.36%**		85%		86.10%	**85.66%**	**86.4%**
Wood and wood products			68%	80%	**80.00%**		85%		82.00%	**84.68%**	**86.4%**
Construction			63%	80%	**68.60%**				82.00%	**82.00%**	**86.4%**
Textile, leather & clothing industry			68%	88%	**75.85%**				90.20%	**65.56%**	**86.4%**
Other industries			65%	85%	**65.00%**		85%		87.13%	**87.13%**	**86.4%**

Calculation of useful energy demand was carried out, for each sub-industrial sector and the respective values are presented at the Table I-34.

Table I-34: Forecast useful energy demand (GWh/year), for the energy services of each sub-industrial sector for baseline scenario

Energy Services (ES)	2023	2030	2035	2040	2045	2050
Iron & steel industry						
High Temperature energy	185.22	230.23	265.82	298.54	328.22	354.78
Low Temperature energy	17.77	23.25	27.85	32.44	37.00	41.50
Cooling	3.64	4.52	5.20	5.83	6.40	6.90
Mechanical/motive energy	87.41	108.37	124.89	139.98	153.58	165.64
Chemical industry						
High Temperature energy	91.16	113.95	132.12	149.03	164.58	178.72
Low Temperature energy	3.16	4.13	4.95	5.77	6.58	7.37
Cooling	6.66	8.17	9.34	10.38	11.29	12.06
Mechanical/motive energy	30.32	37.21	42.54	47.29	51.43	54.96
Non-ferrous metal industry						
High Temperature energy	120.96	151.10	175.10	197.40	217.88	236.47
Low Temperature energy	2.89	3.78	4.53	5.28	6.02	6.75
Cooling	2.10	2.59	2.97	3.31	3.61	3.88
Mechanical/motive energy	50.36	62.08	71.22	79.45	86.75	93.08
Non-metallic minerals						
High Temperature energy	1094.60	1277.98	1406.65	1501.68	1564.09	1595.46
Low Temperature energy	334.94	389.21	427.08	454.63	472.29	480.63
Cooling	1.45	2.47	3.32	4.17	4.99	5.74
Mechanical/motive energy	34.84	59.29	79.63	100.11	119.74	137.67
Transport equipment						
High Temperature energy	*39.80*	*49.23*	*56.63*	*63.38*	*69.42*	*74.75*
Low Temperature energy	*3.53*	*4.65*	*5.59*	*6.55*	*7.50*	*8.46*
Cooling	*0.55*	*0.68*	*0.78*	*0.87*	*0.95*	*1.03*
Mechanical/motive energy	*17.69*	*21.89*	*25.18*	*28.18*	*30.86*	*33.23*
Machinery						
High Temperature energy	*17.75*	*22.12*	*25.58*	*28.78*	*31.70*	*34.33*
Low Temperature energy	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Cooling	*0.85*	*1.06*	*1.23*	*1.39*	*1.53*	*1.65*
Mechanical/motive energy	*27.62*	*34.41*	*39.80*	*44.78*	*49.33*	*53.42*
Mining and quarrying						
High Temperature energy	*40.33*	*50.28*	*58.17*	*65.45*	*72.08*	*78.04*
Low Temperature energy	*69.40*	*87.75*	*102.57*	*116.67*	*129.93*	*142.30*
Cooling	*5.24*	*6.58*	*7.65*	*8.65*	*9.57*	*10.42*
Mechanical/motive energy	*169.37*	*212.63*	*247.23*	*279.62*	*309.56*	*336.93*
Food, drink & tobacco industry						
High Temperature energy	*74.50*	*101.91*	*126.05*	*151.71*	*178.81*	*207.28*
Low Temperature energy	*232.08*	*318.88*	*395.64*	*477.69*	*564.81*	*656.80*
Cooling	*32.89*	*43.60*	*52.69*	*61.92*	*71.22*	*80.51*
Mechanical/motive energy	*93.60*	*124.08*	*149.96*	*176.24*	*202.70*	*229.13*
Paper and printing						
High Temperature energy	*45.90*	*55.18*	*62.17*	*68.12*	*73.02*	*76.92*
Low Temperature energy	*13.06*	*16.73*	*19.74*	*22.66*	*25.46*	*28.12*
Cooling	*1.27*	*1.56*	*1.78*	*1.98*	*2.16*	*2.31*
Mechanical/motive energy	*30.53*	*37.40*	*42.75*	*47.53*	*51.75*	*55.40*
Wood and wood products						
High Temperature energy	*0.94*	*1.05*	*1.10*	*1.12*	*1.11*	*1.06*

Low Temperature energy	17.72	22.71	26.79	30.75	34.55	38.17
Cooling	0.43	0.48	0.51	0.52	0.51	0.49
Mechanical/motive energy	8.25	9.17	9.69	9.87	9.73	9.29
Construction						
High Temperature energy	0.00	0.00	0.00	0.00	0.00	0.00
Low Temperature energy	0.00	0.00	0.00	0.00	0.00	0.00
Cooling	1.57	2.02	2.38	2.73	3.07	3.39
Mechanical/motive energy	155.82	199.62	235.52	270.33	303.75	335.58
Textile, leather & clothing industry						
High Temperature energy	6.97	8.66	9.99	11.21	12.32	13.31
Low Temperature energy	13.60	17.80	21.31	24.83	28.32	31.76
Cooling	11.33	14.10	16.30	18.34	20.19	21.85
Mechanical/motive energy	130.26	176.30	203.80	229.19	252.32	273.12
Other industries						
High Temperature energy	3.34	4.36	5.19	6.00	6.78	7.51
Low Temperature energy	10.10	11.81	13.06	14.04	14.79	15.31
Cooling	2.73	3.37	3.87	4.33	4.74	5.10
Mechanical/motive energy	65.42	80.83	92.92	103.92	113.78	122.47

Source: Calculated by the Consultant

Main conclusion of final and useful energy demand for the industry sector are as following:

- Total final energy demand, for private buildings, is increased from 4,715.41 GWh (2023) to 8,550.85 GWh (2050) for baseline scenario (BLS) (figure I-64). Meanwhile, total useful energy demand is 8,550.85 GWh (2050) for BLS (figure I-65).
- Total final high temperature heat energy demand, for the industry sector, is increased from 2,609.08 GWh (2023) to 4,026.18 GWh (2050) for BLS (figure I-66). Meanwhile, total useful high temperature heat energy demand is 2,858.62 GWh (2050) for BLS (figure I-67).
- Total final lower temperature heat energy demand, for the industry sector, is increased from 941.83 GWh (2023) to 1,925.26 GWh (2050) for BLS (figure I-68). Meanwhile, total useful low temperature heat energy demand is 1,457.16 GWh (2050) for BLS (figure I-69).
- Total final cooling energy demand, for the industry sector, is increased from 82.98 GWh (2023) to 190.32 GWh (2050) for BLS (figure I-70). Meanwhile, total useful cooling energy demand is 155.33 GWh (2050) for BLS (figure I-71).

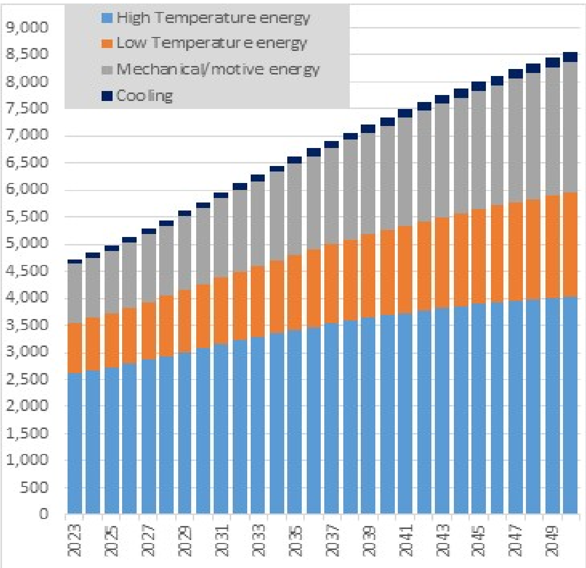


Figure I-64: Industry Final Energy Services forecast for BL Scenario, in GWh

Source: Calculated by the Consultant

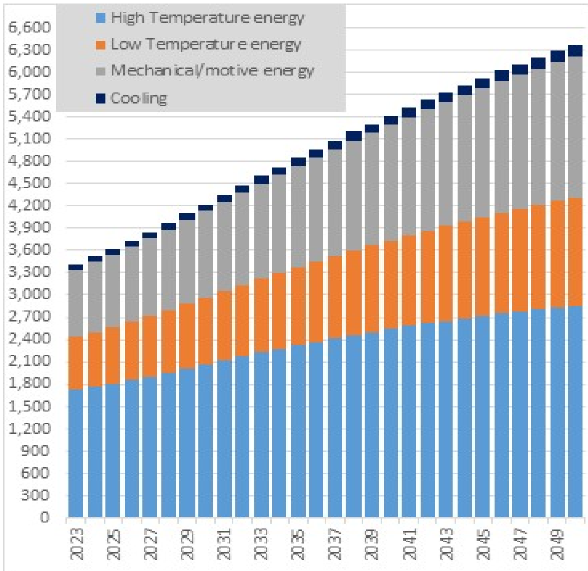


Figure I-65: Industry Useful Energy Services forecast for BLS, in GWh

Source: Calculated by the Consultant

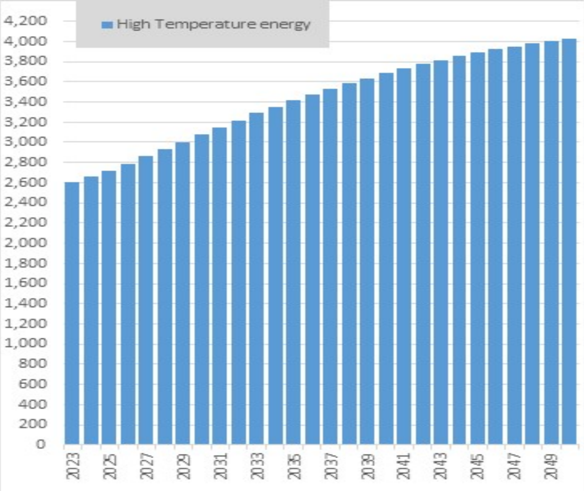


Figure I-66: Industry Final Energy High Temperature Heat Energy forecast for BL Scenario, in GWh

Source: Calculated by the Consultant

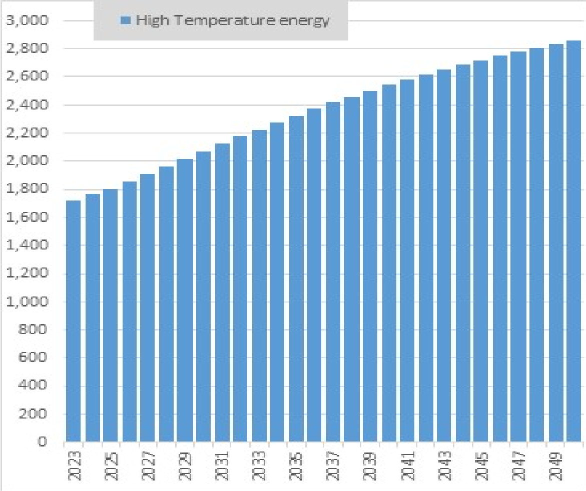


Figure I-67: Industry Useful Energy High Temperature Heat Energy forecast for BL Scenario, in GWh

Source: Calculated by the Consultant

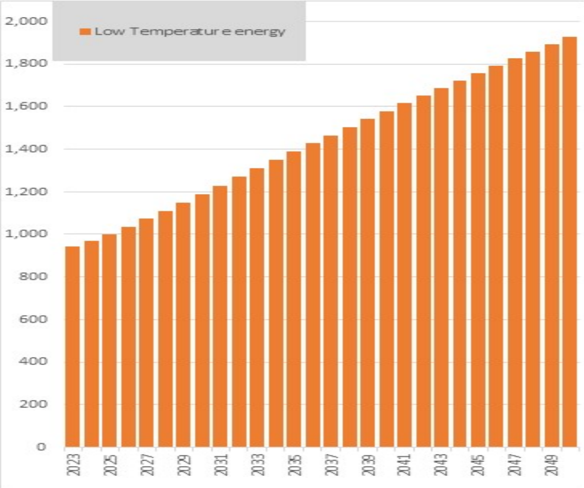


Figure I-68: Industry Final Energy Low Temperature Heat Energy forecast for BL Scenario, in GWh

Source: Calculated by the Consultant

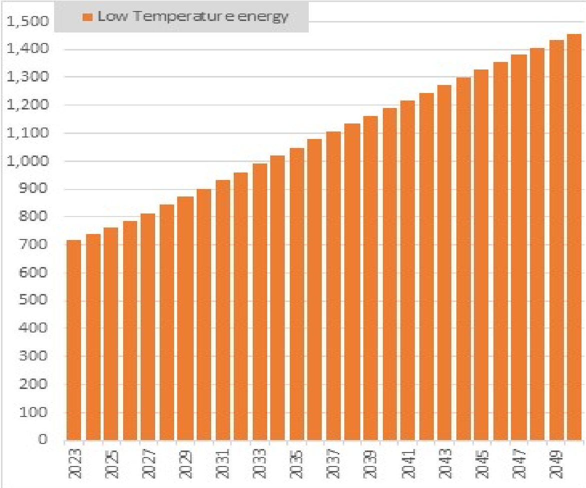


Figure I-69: Private Buildings Useful Energy Low Temperature Heat Energy forecast for BL Scenario, in GWh

Source: Calculated by the Consultant

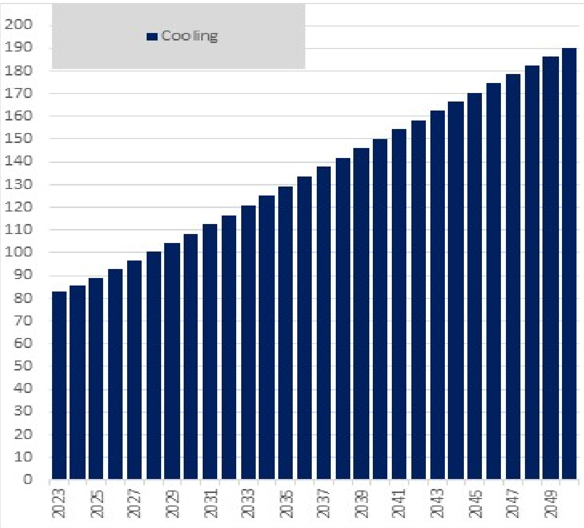


Figure I-70: Industry Final Energy Cooling forecast for BL Scenario, GWh

Source: Calculated by the Consultant

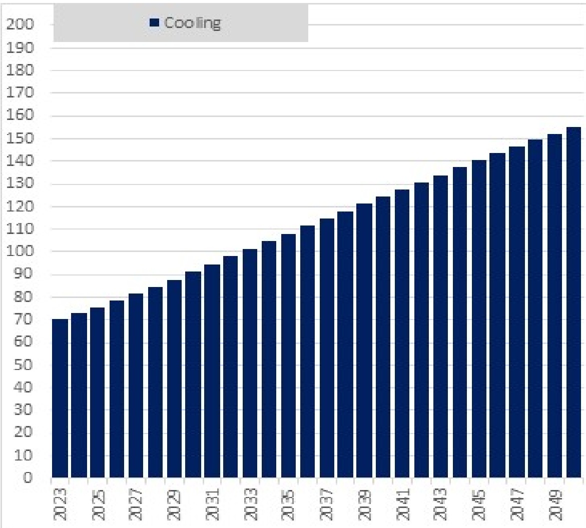


Figure I-71: Industry Useful Cooling forecast for BL Scenario, in GWh

Source: Calculated by the Consultant

I.3 Identification of current heating and cooling supply systems for each sector

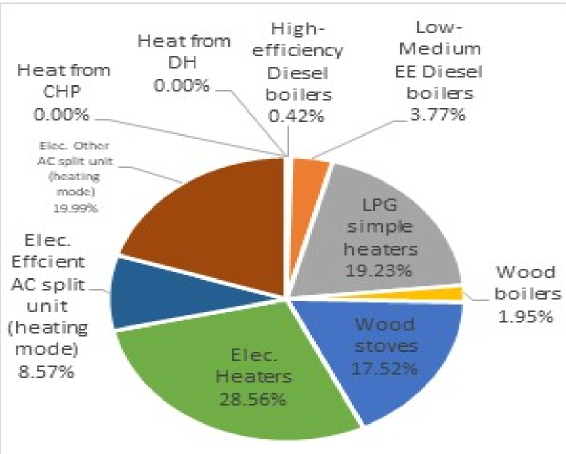
I.3.1 Residential Sector

The total energy delivered to Albanian's household sector was modelled down to the level of individual municipalities, including the following energy commodities in the excel model:

- Electricity;
- Diesel;
- Liquefied petroleum gas;
- Firewood;
- Wood pellets / wood chips / briquettes;
- Solar energy (solar collectors);
- Energy taken from the environment using heat pumps.

The annual consumption of lignite and the natural gas was excluded from the model because they do not exist in the energy balance and the unknown distribution of lignite consumption at the level of individual municipalities. Also, the model of delivered energy includes the energy taken from the environment using heat pumps, which is not included in the total 2023 final energy consumption of the household sector according to the Eurostat method. Given that delivered energy in the templates (in Excel file format) consultant team prepared and includes:

- All energy entering the building through the system boundary (electricity, LPG, diesel);
- Renewable energy entering through the system boundary (e.g. wood, pellets);
- Energy from renewable energy sources generated on the site of the building (e.g. heat generated on- site using solar collectors, heat taken from the environment using heat pumps);
- Heat taken from the environment using heat pumps also needs to be included in the balance of delivered energy. When it comes to heat pumps, only the electricity used to drive compression heat pumps is currently included in the energy balance. Where electricity is used for space heating in the household sector, it is important for the model to differentiate between direct electric resistance space heating (electric heaters, electric boilers) and space heating using compression heat pumps (AC split unit and central AC system). Consultant team together with AEE has carried out the Residential Energy Survey with main goal for recognition of all technical systems for all energy services including the use of compression heat pumps and direct electric resistance space heating in the household sector based on the surveys conducted. Heating of building space in the household sector is all decentralised (individual split air-conditioning, individual stoves and central heating (serving only to individual house or individual apartments). In Albania does not exists any centralised (boilers, heat pumps, DHS) supplying heat and/or hot water for Multi Apartment Buildings (MAB). The distribution of the total energy delivered for space heating by different heating systems is provided in the figure I-72 for the base year 2023. Meanwhile, Figure I-73 presents the baseline scenario breakdown for different heating systems.



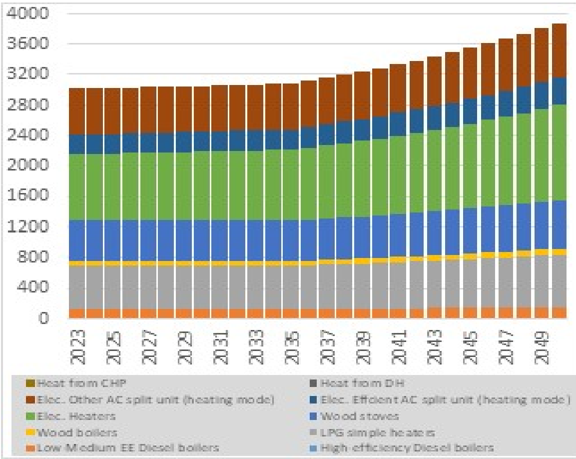


Figure I-72: Distribution of the residential total energy delivered for space heating by different heating systems, %
Source: Calculated by the Consultant

Figure I-73: Distribution of the residential total energy delivered for space heating by different heating systems for baseline scenario, GWh
Source: Calculated by the Consultant

Furthermore, based on data secured by CENCUS-2023 approximately 75-85% of the total energy delivered for space heating in the household sector is consumed using a room-based, that is, a decentralised space heating system (individual stoves, split air conditioning). Merely 15-25% of the total energy delivered for space heating is consumed using central heating system. Cooling of building space in the household sector is all decentralised (mostly are individual split air-conditioning and very rare central AC system) and figures I-74 & I-75 presents the shares of above-mentioned technologies and the baseline scenario breakdown for different space cooling systems.

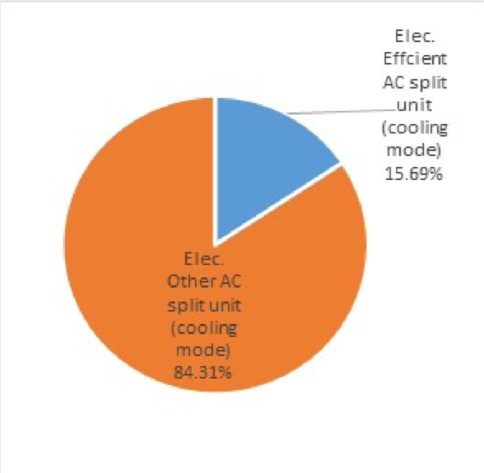


Figure I-74: Distribution of the residential total energy delivered for space cooling by cooling systems, %
Source: Calculated by the Consultant

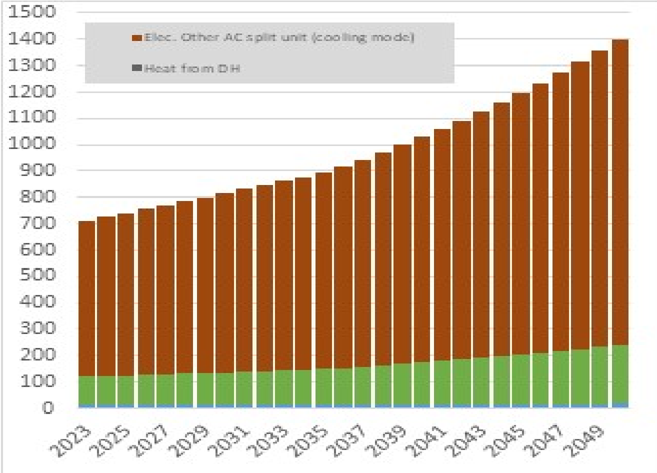


Figure I-75: Distribution of the residential total energy delivered for space cooling by different cooling systems for baseline scenario, GWh
Source: Calculated by the Consultant

Domestic hot water in the household sector is generated using almost decentralised systems based mostly on electrical boilers and solar hot water systems. Family houses use approximately 68% of the total energy delivered for DHW preparation, while the remaining 32% is used by multi-apartment buildings.

I.3.2 Public Building Service Sub-Sector

In general, three types of heating systems are used in public buildings, based on over 200 energy audits conducted by consultants over the last five years under the WB and Smart Energy Municipality Project (SEMP) financed by SECO:

- Electricity: Used for individual electric heaters, fans, air conditioning (AC) units, and split AC units. This system is primarily found in central administration buildings, healthcare facilities, and educational buildings, mostly in climate zone 1;
- Diesel and Fuel Oil: Used for central heating systems with fuel boilers. This system is commonly found in central administration buildings and, to a lesser extent, in health/social buildings, primarily in climate zones 2 and 3. LPG is mostly used for cooking and heating through individual gas stoves;
- Wood (Firewood, Wood Pellets, or Wood Chips): Used in individual central heating systems with fuel boilers. This system is primarily used in municipal administration, educational buildings, and health/social facilities, mostly in climate zones 2 and 3;
- Electricity-heated public buildings: The efficiency of decentralized units (usually room-based) is high, but only a few are equipped with heat pump modes in the AC units. There are no losses in heat distribution. Most AC units are used for both heating and cooling based on indoor temperature demands, with little control over energy consumption by the building operator. As a result, electric-heated buildings generally offer low levels of heating comfort;
- Diesel or fuel oil-heated buildings: The efficiency of heat generation in the boilers is low to medium (60-80%) due to poor maintenance. Significant heat distribution losses occur because of unbalanced heating systems and the lack of temperature control in rooms. The real cost of diesel

energy is 4-5 times higher than that of firewood. Diesel supply can be controlled or limited by the building operator. Diesel/fuel oil-heated buildings typically offer moderate heating comfort;

- Heating by LPG heaters: Room-based LPG heaters are highly efficient (>85%) and are often used as backups to electric heaters. There are no heat distribution losses. However, LPG cannot be used in highly populated rooms or for extended periods due to the hazardous exhaust gases. The real cost of LPG energy is 2.5-3 times higher than that of firewood. LPG supply can be controlled or limited by the building operator. LPG-heated buildings generally offer moderate heating comfort, even when combined with electric heaters;
- Buildings with wood stoves: Wood stoves are typically found only in populated rooms, leaving corridors and other spaces unheated. The efficiency of heat generation in the stoves is low (30-50%), requiring significant manual effort for heating. Smoke from the stoves causes air pollution in the rooms, leading to health hazards. The real cost of firewood is low, making it an attractive option for municipalities, especially those using their own forests to procure firewood at even lower prices. Firewood supply can be controlled or limited by the building operator. Wood stove-heated buildings usually offer low levels of heating comfort;
- Buildings heated by wood pellets: The efficiency of heat generation in the boilers is medium to high (70-85%) due to their large capacity and dedicated operation staff. Moderate heat distribution losses occur due to unbalanced heating systems and the lack of temperature control in rooms. The real cost of wood pellets is low, making it an attractive option for building users. The supply of wood pellets can be controlled or limited by the building operator. Wood pellet-heated buildings generally provide moderate to high levels of heating comfort.

The analysis carried out based on more than 200 Energy Audits for different public buildings have clearly shown that in general comfort conditions are not fulfilled. Fuel poverty (partly due to shortage of the municipality budget) and the security of supply have meant lower consumption to meet final energy demand to fulfil comfort conditions for all energy services. The “real consumption” depends on the following factors and can vary significantly for different types of public buildings:

- Budget of municipality dedicated for fulfilling energy services;
- Location of the building in a climate zone;
- Level of occupancy by users, the operation time as well as the level of heated area (partly not use or heated);
- Technical condition of the building envelope, which determines the losses;
- Technical type of energy and conditions of the heat generation (wood/ diesel /electric heating).

The distribution of the total energy delivered for space heating by different heating systems for public building service sub-sector is provided in the figure I-76 for the base year 2023. Meanwhile, figure I-77 presents the baseline scenario breakdown for different space heating systems.

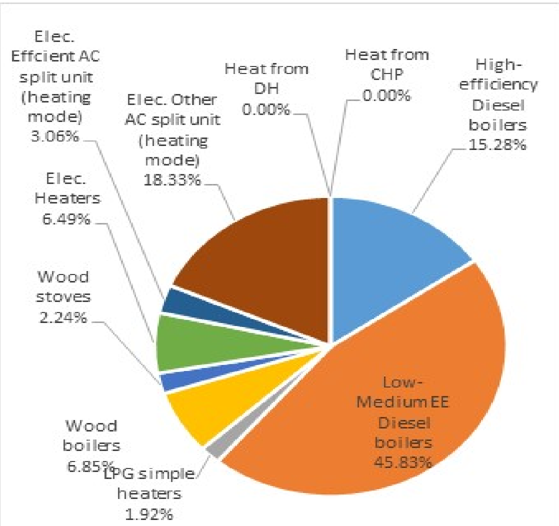


Figure I-76: Distribution of the public buildings total energy delivered for space heating by different heating systems, %
Source: Calculated by the Consultant

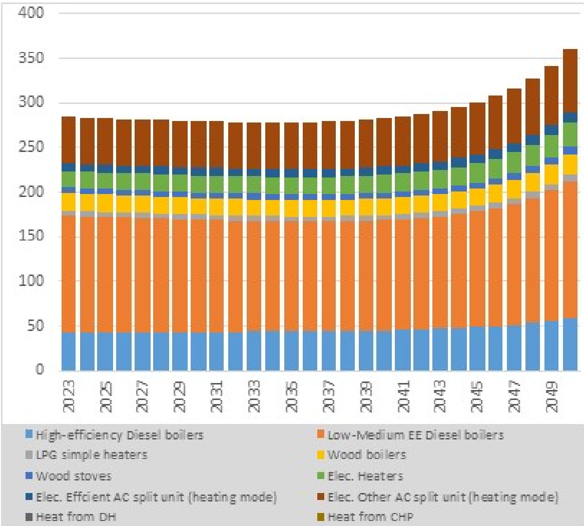


Figure I-77: Distribution of the public buildings total energy delivered for space heating by diff. heating systems for BL scenario, GWh
Source: Calculated by the Consultant

Cooling of building space in the public building sub-sector is mostly in central buildings and very few in the public municipal buildings. Most of the AC systems are decentralised (mostly are individual split air-conditioning and very rare central AC system especially for very important central governmental buildings) and figures I-78 & I-79 presents the shares of above-mentioned technologies and the baseline scenario breakdown for different space cooling systems.

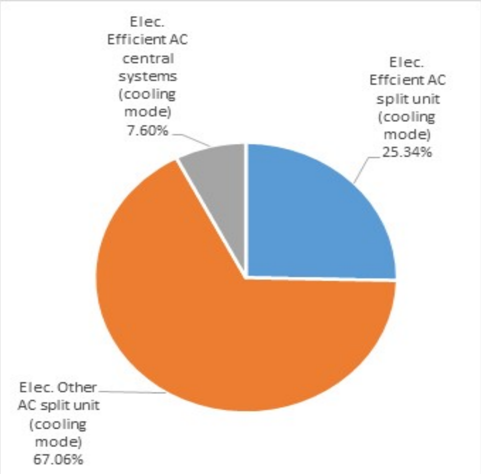


Figure I-78: Distribution of the total energy delivered for space cooling by different cooling systems, %
Source: Calculated by the Consultant

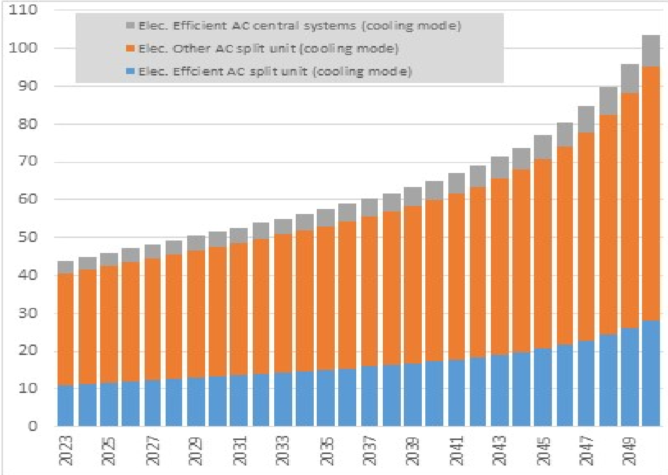


Figure I-79: Distribution of the public buildings total energy delivered for space cooling by different cooling systems for baseline scenario, GWh
Source: Calculated by the Consultant

Sanitary hot water in the public buildings sub-sector is generated using almost decentralised systems based mostly on electrical boilers (approx. 70-75%), central heating systems (approx. 10-15%) and solar hot water systems (approx. 10-15%).

I.3.3 Private Building Service Sub-Sector

The Private Services sector is currently undergoing a transformation, marked by the accelerated adoption of modern energy technologies and installations. In recent years, there has been a notable increase in the use of solar energy systems, particularly solar water heating systems (SWHS) and photovoltaic (PV) auto producers. As a result, many private service providers have already achieved, and are expected to continue achieving, significant advancements in both technology and service quality. This sector includes a wide range of businesses such as hotels, restaurants, banks, tourist and consulting offices, insurance agencies, and others. It also encompasses private services that parallel public services in fields like education, culture, and healthcare—sectors where ensuring maximum comfort for clients is a key priority.

As previously mentioned, the most recent energy survey for the service sector was conducted by USAID in 2016 to support the development of the Energy Strategy adopted in 2018. It is also important to note that some sub-sectors within Private Services—such as traditional repair services and small-scale trade—still operate with limited or no demand for heating or air conditioning, due to either infrastructural constraints or the nature of their services. One of the most important sectors of private services in Albania is tourism, which includes: hotels, motels, resorts, restaurants, recreation centers, etc. Tourism is one of the main sectors in accelerating sustainable economic development and it is the Albanian Government's main strategic sector. The broad impact on economic activity ranks the tourism sector as one of the main factors in economic growth and employment. The number of foreign visitors who have come to Albania shows high rates of growth, going from 317 thousand visitors in 2000 to 12 million foreign visitors in 2023. The increase in the number of tourist buildings, restaurants, guesthouses has increased the energy consumption in this sector.

The distribution of the total energy delivered for space heating, for private service building stock, by different heating systems is provided in the figure I-80 for the base year 2023. Meanwhile, figure I-81 presents the baseline scenario breakdown for different space heating systems for private service building stock.

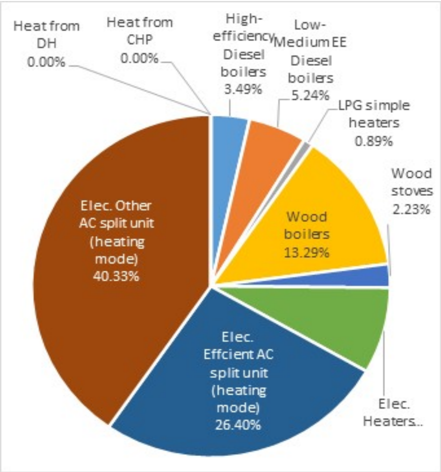


Figure I-80: Distribution of the private buildings total energy delivered by heating systems, %
Source: Calculated by the Consultant

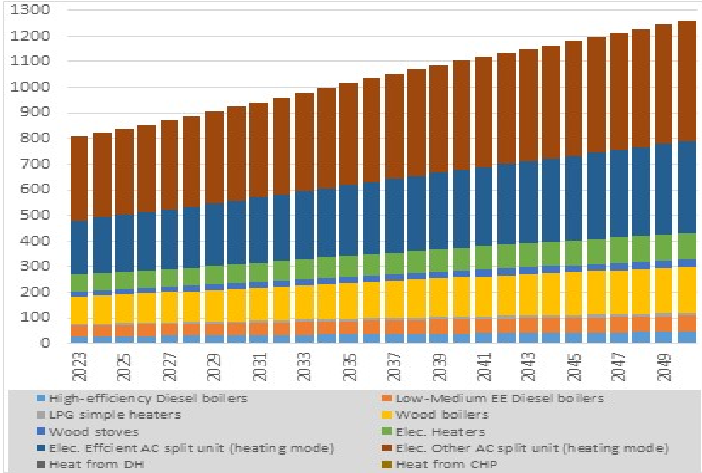


Figure I-81: Distribution of the private buildings total energy delivered for space heating by diff. heating systems for baseline scenario, GWh
Source: Calculated by the Consultant

Furthermore, based on data secured by CENCUS-2023 approximately 75-85% of the total energy delivered for space heating in the household sector is consumed using a room-based, that is, a decentralised space heating system (individual stoves, split air conditioning). Merely 15-25% of the total energy delivered for space heating is consumed using central heating system.

Cooling of building space in the private building stock sector is approx.. 82% decentralised (mostly are individual split air-conditioning and very rare central AC system) and figures I-82 & I-83 presents the shares of above-mentioned technologies and the baseline scenario breakdown for different space cooling systems.

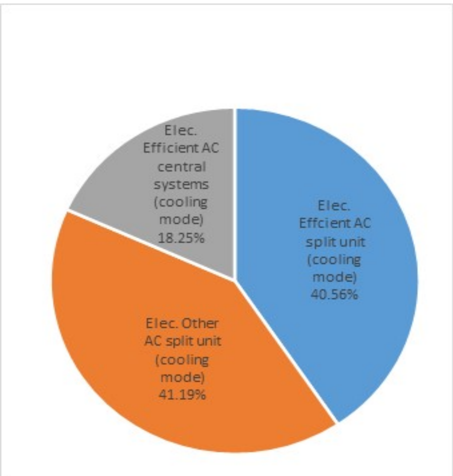


Figure I-82: Dist. of the private buildings total energy delivered for space cooling by different systems, %
Source: Calculated by the Consultant

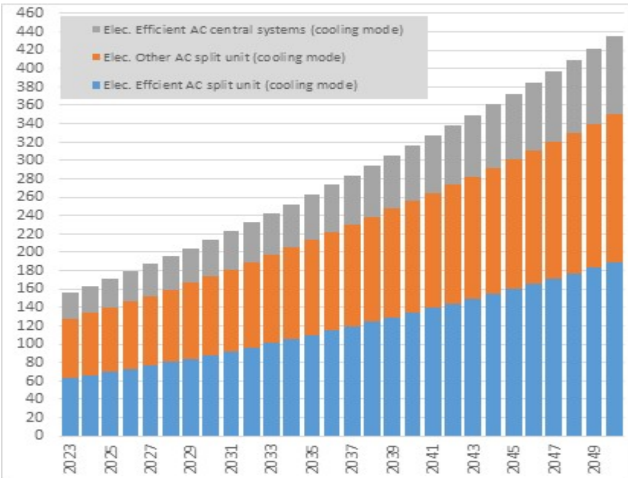


Figure I-83: Distribution of the private buildings total energy delivered for space cooling by different cooling systems for baseline scenario, GWh
Source: Calculated by the Consultant

Domestic hot water in the household sector is generated using almost decentralised systems based mostly on electrical boilers and solar hot water systems.

I.3.4 Industry Sector

The total energy delivered to Albanian's industry sector was modelled down to the level of municipalities, including the following energy commodities in the excel model:

- Coal and lignite;
- Natural gas
- electricity,
- Heavy Fuel Oil

- Diesel,
- Liquefied petroleum gas,
- Firewood,
- Wood pellets / wood chips / briquettes,
- Solar PV Autoproducers,
- Solar energy (solar collectors)
- Energy taken from the environment using heat pumps.

The annual consumption of lignite and the natural gas is included from the model because they do exists in the energy balance and consultant team has assumed their distribution of consumption at the level of municipalities based on the most well-known industrial enterprises reported from INSTAT. Also, the model of delivered energy includes the energy taken from the environment using heat pumps, which is not included in the total 2023 final energy consumption of the household sector according to the Eurostat method. Given that delivered energy in the templates (in Excel file format) consultant team prepared and includes:

- all energy entering the industrial subsectors through the system boundary (coal, natural gas, HFO, electricity, LPG, diesel),
- renewable energy entering through the system boundary (e.g. wood, pellets),
- energy from renewable energy sources generated on the site of the building (e.g. electricity generation from roof-top PV Autorpoducer systems, heat generated on- site using solar collectors, heat taken from the environment using heat pumps),
- heat taken from the environment using heat pumps also needs to be included in the balance of delivered energy (as consumption to the industrial sectors as well as). When it comes to heat pumps, only the electricity used to drive compression heat pumps is currently included in the energy balance.
- Consultant team carry out the Final Energy Demand Forecast for sub-industrial subsector, for each of the following energy service category: 1) low temperature process heating (LTPH); 2) high temperature process heating (HTPH); 3) motive power (MP) and 4) cooling (including space cooling for office and workshops as well as cooling for industrial processes). Heating of industrial buildings is included as part of the LTPH, meanwhile cooling of industrial of building is part of space cooling for office and workshops as well as cooling for industrial processes.

EECG consultant team collected the respective data for main industrial customers related to the current heating and cooling supply: (a) by technology, in GWh per year, thermal capacity of boilers and furnace and the respective data are presented at the table I-35.

Table I-35: Distribution of industrial enterprises based on their consumption and heat capacity

Nr	Main Heat & Electricity Costumers	Electricity Consumption, MWh		Fuel used by industry	Fossil Fuels Consumption, MWh		Effective Boiler/Furnace capacity, MW_{th}	Waste heat source temp. ^0C	Estimated technically recoverable heat, MWh_{th}
		2023	2024		2023	2024			
1	Cement Factory Colacem Albania, Elbasan	15,641	15,638	Coal	46,924	46,914	15.30	300-350 0C	7,742
2	Steel Factory "Kurum", Elbasan	116,381	134,127	Coal	174,571	201,190	65.62	580-600 ^0C	36,660
3	Ferrochromium Burrel	60,884	49,208	Coal/Residual Heavy Fuel Oil	20,747	16,768	5.47	580-600 ^0C	3,838
4	Ferrochromium Elbasan (AES)	65,273	60,043	Coal/Residual Heavy Fuel Oil	22,242	20,460	6.67	580-600 ^0C	4,004
5	Cement Factory Fushkruje	46,077	81,557	Coal	138,232	244,672	79.80	300-350 ^0C	22,117

6	Cement Factory (Titan), Fushekruje	109,885	100,481	Coal	329,654	301,442	98.32	300-350 ^{0}C	59,997
7	GSA-Cement Factory Elbasan	172,144	79,981	Coal	58,659	27,254	8.89	300-350 ^{0}C	9,679
8	Lajthiza Water Production, Puke	1,920	2,581	Heavy Fuel Oil	237	319	0.10	180-220 ^{0}C	32
9	CWI (CWI-ALBANIA (ÇOKYASAR WIRE INDUSTRY ALBANIA)), Elbasan	4,629	5,783	Heavy Fuel Oil	2,492	3,114	1.02	580-600 ^{0}C	473
10	Beralb (RT minerals), Puke	14,568	13,354	Heavy Fuel Oil	4,109	3,767	1.23	580-600 ^{0}C	760
11	Ballsh Refinery	Out of operation, completely dismantled and actually a PV Plant with installed capacity 100 MW is in the process of construction							
12	Fier refinery	Out of operation, completely dismantled							
13	Cerrik Refinery	Out of operation, completely dismantled							
14	Kucove Refinery	Out of operation, completely dismantled							

The energy demand of the cement production process depends predominantly on individual circumstances, mainly the local raw material moisture and the individual plant layout. Plants with a high raw material moisture content exhibit a higher specific energy demand. But since more energy is utilised for raw material drying, the energy performance may be even higher. Further waste heat recovery in other drying processes (mineral components for cement production, alternative fuels) for electricity generation or heat export (e.g. district heating) may increase the energy performance where feasible from a technical and economical point of view. The specific characteristics of the fuels used have an impact on the overall energy demand. An increase in alternative fuel use – depending on the respective fuel properties – may lead to a moderate increase in the specific energy demand but also increases the potential for the application of further waste heat recovery measures. Waste gases temperature in the cement factories in Albania are at the range of 300-350 ^{0}C and consultant team has calculated for each cement factory the energy technical potential of the waste heat and the respective results are presented at the table I-35.

The heat energy from the hot waste gas from the ferrochromium furnaces ranging from approximately 580-600°C at the gas stack down to 200°C at the bag filter plant are a great technical and practical heat potential to be recovered by evaporative cooling and transformed into steam, which then can used for heat or electric power generation. The system applied to the newer arc furnaces is designed for a very good efficiency range from 580°C-600°C. The boiler system will be composed by an economizer, evaporator, super heater, screen, steam drum and blowdown tank. Inlet temperature of the flue gas into the boiler (steam generator) will be approximately 580-600°C and the outlet temperature is approximately 180°C or less for condensing boiler. Consultant team has calculated for each ferrochromium furnaces the energy technical potential of the waste heat and the respective results are presented at the table I-35.

The distribution of the total energy delivered for HTPH and LTPH by different heating systems is provided in the figure I-84 for the base year 2023. Meanwhile, figure I-85 presents the baseline scenario breakdown for different HTPH and LTPH heating systems. Analysis of both figures shows clearly that actually does not exists and for baseline scenario are not foreseen HTPH and LTPH supplied by DH and CHP plants.

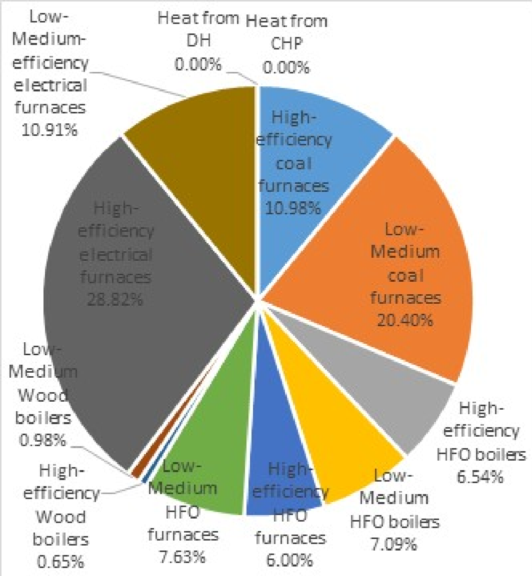


Figure I-84: Distribution of the industry total energy delivered for HTPH and LTPH by different systems, %

Source: Calculated by the Consultant

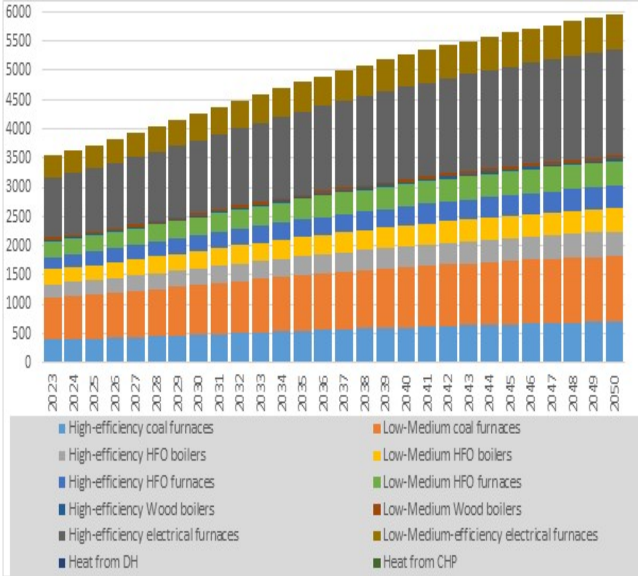


Figure I-85: Distribution of the industry total energy delivered for HTPH and LTPH by different systems for baseline scenario, GWh

Source: Calculated by the Consultant

Cooling of industrial enterprises are presented I-86 & I-87 presents the shares of above-mentioned technologies and the baseline scenario breakdown for different space cooling systems.

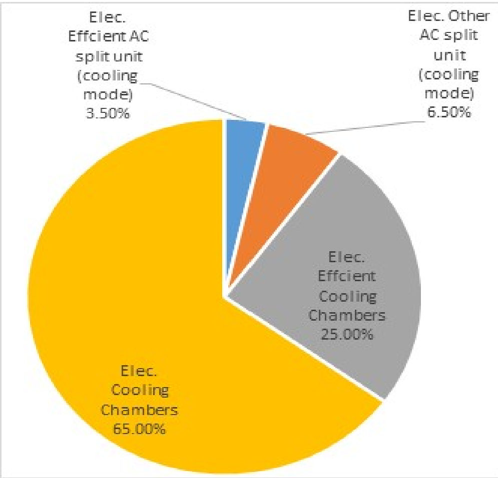


Figure I-86: Distribution of the industry total energy delivered for space cooling by different cooling systems, %

Source: Calculated by the Consultant

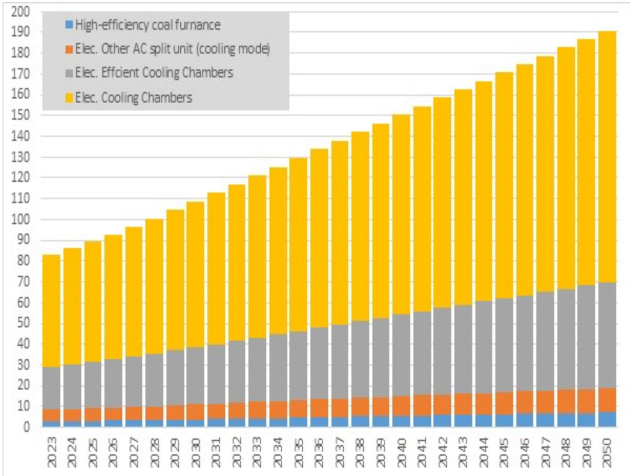


Figure I-87: Distribution of the industry total energy delivered for space cooling by different cooling systems for baseline scenario, GWh

Source: Calculated by the Consultant

Table I-35.1 presents the respective energy commodities in GWh/year (for heating) distinguishing between energy derived from fossil and renewable sources: i) provided on-site in residential and service sites; and ii) provided on-site in non-service. So, the regrouped into the required format (GWh/year by technology, distinguishing fossil and renewable sources) are presented at the table I-35.1 for the respective energy commodities.

Table I-35.1: Respective energy commodities in GWh/year distinguishing between energy derived from fossil and renewable sources

Sector	Energy Commodities	Main Technologies	Units	2023	2030	2040	250
Residential Sector	Fossil fuel sources	Heat only boilers	GWh/a	126.28	125.93	132.48	152.81
		Other technologies	GWh/a	579.54	575.74	602.22	690.47
		HECHP	GWh/a	0	0	0	0
	RES	Heat only boilers	GWh/a	586.77	585.18	615.62	710.11

		HECHP	GWh/a	0	0	0	0
		Heat Pumps	GWh/a	856.13	864.83	920.09	1073.71
		Other technologies	GWh/a	865.01	900.04	1012.09	1246.11
Central and Municipal Public Buildings Sector	Fossil fuel sources	Heat only boilers	GWh/a	173.67	169.28	168.78	212.04
		Other technologies	GWh/a	5.47	5.48	5.69	5.47
		HECHP	GWh/a	0	0	0	0
	RES	Heat only boilers	GWh/a	25.84	25.18	25.10	31.53
		HECHP	GWh/a	0	0	0	0
		Heat Pumps	GWh/a	60.78	60.95	63.24	82.65
		Other technologies	GWh/a	18.45	18.78	18.53	26.49
Private Service and Commercial Buildings Sector	Fossil fuel sources	Heat only boilers	GWh/a	70.42	80.26	95.52	108.39
		Other technologies	GWh/a	7.20	8.39	10.31	12.07
		HECHP	GWh/a	0	0	0	0
	RES	Heat only boilers	GWh/a	125.29	146.04	179.39	209.97
		HECHP	GWh/a	0	0	0	0
		Heat Pumps	GWh/a	538.57	613.68	730.20	828.39
		Other technologies	GWh/a	65.61	74.93	89.44	101.80
Industry Sector	Fossil fuel sources	Heat only boilers	GWh/a	1114.44	1330.70	1628.91	1826.95
		Other technologies	GWh/a	232.35	284.30	360.18	417.84
		HECHP	GWh/a	0	0	0	0
	RES	Heat only boilers	GWh/a	464.70	557.16	686.08	774.11
		HECHP	GWh/a	0	0	0	0
		Heat Pumps	GWh/a	57.79	69.14	84.86	95.45
		Other technologies	GWh/a	271.07	319.37	383.29	421.18

Source: Calculated by the Consultant

I.4 Aggregated data on cogeneration units in existing district heating and cooling networks

During the period 1960-1980, Combine Heat and Power Plants (CHP) in Albania has been more developed than Heat only Boilers (HOB), which from their side are used only in hospitals, Student City, industry, institutional buildings and in any other small place. CHP, instead of HOB, has played an important role in supplying technological process heat to industrial customers. HOB has provided 3-4 times higher heat than heat supplied by CHP as it is presented in the table I-36.

Table I-36: Distribution of CHPs existing systems

Nr	Main Heat & Electricity Costumers	2023	2024	2023	2024	Effective Boiler/Furnace capacity, MWth
		Electricity Consumption, MWh		Fossil Fuels Consumption, MWh		
1	Ballsh Refinery	Out of operation, completely dismantled and actually a PV Plant with installed capacity 100 MW is in the process of construction				
2	Fier refinery	Out of operation, completely dismantled				
3	Cerrik Refinery	Out of operation, completely dismantled				
4	Kucove Refinery	Out of operation, completely dismantled				
5	Fier Cogeneration TPP	Out of operation, completely dismantled				
6	Vlora Thermal Power Plant	Vlora Thermal Power Plant with installed capacity 97 MW as combined cycle with 2-Gas Turbine and 1-Steam Turbine, fully condensate cycle; completely constructed and not yet in commissioned due to disagreement with contractor				
7	Korca Cogeneration TPP	Out of operation, completely dismantled				
8	Maliq Cogeneration TPP	Out of operation, completely dismantled				
9	Tirana Cogeneration TPP	Out of operation, completely dismantled				
10	Cerrik Cogeneration TPP	Out of operation, completely dismantled				
11	Kucova Cogeneration TPP	Out of operation, completely dismantled				
12	Elbasan Cogeneration TPP	Out of operation, completely dismantled				
13	Ballsh Cogeneration TPP	Out of operation, completely dismantled and actually a PV Plant with installed capacity 100 MW is in the process of construction				
14	Elbasan Incinerator	Main parameters will be collected during the first phase of the project				
15	Tirane Incinerator	Main parameters will be collected during the first phase of the project				

16	Fier Incinerator	Main parameters will be collected during the first phase of the project

Source: Collected and prepared by the Consultant

The first thermal power plants installed in the early mid 1950s at Maliq, Kucova, Vlora, and Cerrik, had capacities smaller than 10 MW, and were coal fired thermal power plants. All of the nine thermal power plants installed in Albania produce both heat and power. Four of them, such as Ballshi, Kucova, Cerrik, and Maliq, are dedicated plants providing heat only to the respective refineries, and the other five were planned to provide electricity and heat to a variety of end users. During the 1990s, heat distribution to industrial customers is severely reduced due to low industrial demands. However, many of the older plants have very degraded heat distribution systems, which have not allowed their full capacity. So, all of them are stopped at the end 2000. Based on the aggregated data presented in Table I-36 it can be concluded that there is currently no technically and economically recoverable waste heat or cogeneration-based heat supply potential in Albania.
Table I-36 identifies the Vlora TPP as a condensing thermal power plant primarily designed for electricity generation and it is important to be pointed out that the waste heat recovery is not planned, since the power plant is far from the heat demand centres, so the plant is not equipped or realistically suited for potential heat extraction. Table I-36 describes several historical CHP installations and analysis shows that these plants are no longer operational and all of them have been dismantled. So, since no cogeneration installations are in operation in Albania with a total thermal input exceeding 20 MW, there are no existing installations that can potentially supply waste heat.
District Heating may be defined as the supply of the space heating and hot water to a number of buildings from a central heating plant or a group of heating plants, which are link to each other. In many cases some of them may be a Combined Heat and Power Plants. The heat produced in this plant is delivered to the consumers as hot water or steam through an insulated, double pipe line system. The heated water is carried in the supply pipeline. After giving up its heat, the cooler water returns to the plant for reheating. As it is known, the district heating systems may vary in size from those serving a small group of houses to those covering a whole metropolitan area.

Any kind of fuel or any source of waste heat may be utilised in district heating system, and systems over a certain size may comprise more than one heating station, eventually using different kind of fuels. The pipeline network will often comprise both large line linking the major plants with population centres, as well as smaller lines for distribution to the individual users. The heat is transferred from the transmission lines to the distribution network through heat exchangers.

District Heating gives to the consumer a comfortable and reliable supply. It is easy to use, can't be seen, heard or even smelled. The absence of individual smoke stacks makes it an environmentally sound heating solution. It has a long tradition in many countries dating back to the early decades to previous century. The extent and branching of the system are determined according to the location of the heating plants, the location of consumers, the possibility of the practical placement of the pipes, and a financial evaluation that takes into consideration the heat loss from the pipeline. The larger district heating connection over a given are, the better efficiency. In order to ensure a sufficient supply temperature, the flow and return piping are sometimes "short-circuited" by means of bypasses. Often one distinguishes between the following types of district heating pipes:

- ***Transmission pipes*** leading heat from large heating production plants (e.g. heat and power stations) to one or more local distribution networks, where the heat is transported further on, first passing a heat exchanger.
- ***Main pipes*** leading heat from a heat exchanger/district heating station to the service pipes. The main pipes normally follow streets and roads.
- ***Service or branch pipes*** leading heat from the main pipes to individual consumers.

In following Figure I-88 is given a schematic sketch of a typical District Heating System. Main pipes and service pipes constitute the district heating system.

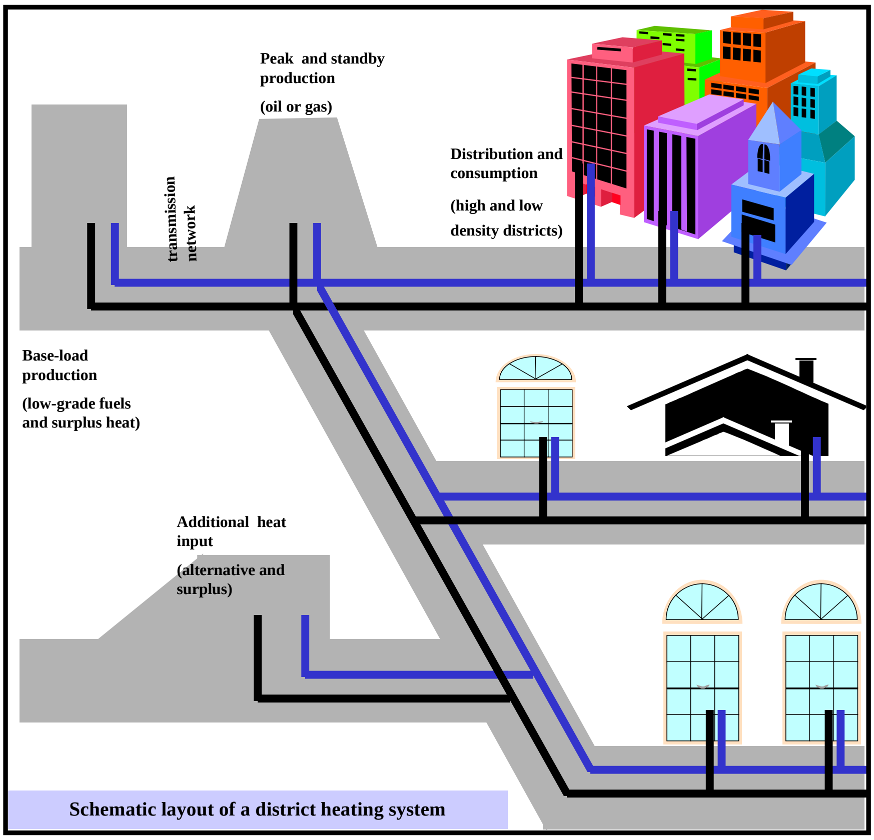


Figure I-88: Schematic Sketch of a typical District Heating System
Source: Prepared by the Consultant

The construction of District Heating Systems requires large investments in capital-intensive installations, not only in productions units built in well-insulated long transmission lines. The economic consequences for the companies and consumers that follow the introduction of a new DH project, a systematic analysis of the socio-economic consequences is necessary for a complete evaluation of the project. A DH system influences many aspects of society such as:

1. Rational use of energy,
2. Environment,
3. Balance of payments,
4. Production facilities,
5. Employment's and demographic development,
6. Health and Education.

Stability of the future heating costs is an important factor for the consumers of district heating. As for the case shown in the figure, fuel cost constitutes only 15 % of the total heating cost; for individual oil-fired installations this figure may exceed 60 %. Economic calculations to justify CHP & DH schemes are carried out at various levels. The most favourable conditions for financing new District Heating Schemes are found in utilities which gradually been built up over many years.

The more rapidly that consumers can be connected to the heating network, the better will be the economy of the operation. Compulsory connections to existing collective systems are often enforced in new building areas. The consumer economy differs from that of the utilities and District Heating Companies. In principles, the DH companies compete in the market and balance the tariffs against competitors such as oil and gas based central heating systems, but the market economy is modified by such energy policy measures as taxation, subsidies, and regulations, including laws relating to the heat supply.

I.5 Aggregated data on existing district heating and cooling networks supplied from cogeneration

The brief analysis given chapter 6 briefly presented that currently no DH/CHP system exists in Albania.

As was also presented above, no DH/CHP system is foreseen in the base scenario. Meanwhile, in the second scenario of efficient and RES heating and cooling supply scenario with much higher penetration compared with NECP-WAM (With Additional Measures) by introducing more efficient and renewable heating and cooling technologies, distinguishing between energy derived from fossil and renewable sources where applicable (which will be analyzed in detail in Part II) DH/CHP supply schemes will occupy an important place in meeting the needs for heating, cooling and hot water.

CHP, cogen or co-generation is defined as simultaneous production of electricity and heat from the same fuel. The phrase "total energy" has been used to describe a range of applications from, for example, an industrial gas turbine using the exhaust gas to raise steam, to much more complex plants involving a large number of processes. There are many definition of total energy schemes, but one of them may be: *A scheme in which the total energy requirements of a plant in the form of power and heat are provided from a supply of primary fuel*.

The definition of total energy given above covers the use of refrigeration, heat pumps, recovery of energy from waste water and waste gases etc., as well as the use of boilers and all types of prime movers used either for electricity generation or for direct mechanical drives. More restricted schemes, which combine electricity generation with heat for ensuring space heating and/or specific industrial processes, are frequently referred to as Combined Heat and Power (CHP) or cogeneration. Schemes in which thermal energy is produced centrally and distributed through (via) pipe networks for the heating of houses and public buildings, such as the Student City, are referred as District Heating Schemes (DH). CHP schemes can incorporate district heating. There are three main types of prime movers used as CHP plants: gas turbines, internal combustion engines and steam turbines.

Gas Turbines. They have captured the largest share of the recent cogeneration market. Typical gas turbines applications range from a few hundred kW to 500 MW. Nowadays, combustion turbines are commercially available in packages ranging from 200 kW to more than 150,000 kW. Those plants have been applied to both base load and peaking application, and provide a number of benefits, including relatively small size, high temperature recoverable heat, high reliability and availability, and relatively low cost maintenance. Much of their success in the cogeneration industry is a result of low initial costs, high availabilities, excellent and low-cost maintenance characteristics, fuel-switching capabilities, high-quality heat that can be simply recovered, and high efficiencies in large sizes.

Gas turbines concepts are simple as compared to other technologies. The simplest open-cycle system operation consists on three major components and operates through a Brayton cycle. Gas turbine cogeneration plants are becoming more popular part, particularly of their optimum heat/power ratio of around 3:1. The CHP plant can now be run with the philosophy of matching the demand for heat, and exporting excess power to help with economics of the plant. This concept will be also used at the Student City. A prime mover (motor) as it is gas turbine with a lower heat/power ratio will help in this concept. A gas turbine used for CHP would normally be fuelled by natural gas and diesel as preferred fuels, but gasified heavy fuel oil can be used as well.

Internal Combustion Engines. All internal combustion engines operate in the same way when acting as CHP units; power is used to drive a generator and heat is recovered from the engine exhaust, jacket water and lubricating oil. The size range is enormous: from the 15 kW diesel/natural gas unit for the use in the domestic/service consumers to 50 MW diesel units (or some time heavy fuel oil) for use in the industrial sector. The largest diesel units operate at heat/power ratios of around 1:1 whereas some other units can operates efficiently around 2:1. Additionally, reciprocating engines are extremely efficient in small sizes, and are available over a broad range of sizes ranging from tens of kW to 50 MW, can be fired on a broad variety of fuels and have excellent availability. As a result, they have been used in a numerous cogeneration systems serving residential, commercial, service, institutional and small industrial loads.

Steam Turbine. Steam-turbine-based power generation cycles have been the workhouse of the power generation industry. They are available in a broad range of sizes from a few hundred kW to more than 1000 MW. After many decades of focusing primarily on increasing system size, the turbine industry has recently turned towards increasing efficiency and availability. Because of their energy characteristics and the need to operate the steaming portion of the cycle, steam-turbine based systems have been used primarily for base load applications, with older plants being relegated to intermediate duty. Finally, because of the availability to extract steam at various ports throughout the expansion process, they allow for grater flexibility in matching cycle thermal capabilities with loads.

The typical steam-turbine-based system consists of several major components: a heat source, a steam power turbine and a heat sink. The system typically operates in a Rankine cycle and, when equipped with a condenser has been the basis of most of the generation capacity brought on line since the early 1900s. A second major component is a heat sink. In as much as the turbine operates by allowing the steam to expand, giving up energy and doing work, the cycle must include a mechanism for rejecting the steam, and the energy therein that is exhausted from turbine. This heat sink can be a thermal process, as is the case with cogeneration systems, or it can be the environment.

Steam turbine technology is quite diverse, operating over a broad range of steam conditions and design concepts. As described below, steam turbines can be categorized in a number of ways, including the process by which steam expands and does the work, the manner in which steam exists the turbine, and the manner in concept: as steam expands while flowing through a nozzle, it accelerates and forms a high-speed-jet. The kinetic energy of the jet is then transferred to a series of rotating blades that produce mechanical work.

turbines can also be categorization of turbines that are based on the procedure by which steam expands and impacts on the turbine blades. Steam turbines can also be categorized as to steam exit conditions. The backpressure or non-condensing turbine is the simplest, consisting of a turbine that exhausts the steam at atmospheric pressures or higher. These turbines are generally used when there is a heating or industrial process need for high-pressure steam and all steam condensation takes place downstream of the turbine cycle and in the load.

The use of backpressure turbines in cogeneration applications does result in some disadvantages as compared to other types of turbines. Since the process load is the heat sink for the steam, the amount of steam passed through the turbine is dependent on the site’s heat load. Thus, the backpressure turbine provides little flexibility in directly matching electrical output to the electrical requirements; electrical output is controlled by the thermal load. The direct linkage of the site steam (or hot water requirements) and electrical output can result in electrical utility charges for standby service or increased supplemental service. As an alternative, it is possible to vent the exhaust steam directly to the atmosphere; however, this practice is very inefficient, results in the waste of treated boiler water, and is likely to lead to poor operating economics. Second the turbine itself tends to be larger than other type of turbines.

Cogeneration cycles can be categorised according to the sequence in which the power and thermal energy are produced. The typical topping cycle cogeneration system produce firstly electricity and after that fuel gases are used to produce heat as by-product. This is based on a gas combustion turbine; however, reciprocating engines and steam turbines are also consistent with topping cycle cogeneration. The turbine drives a generator while the exhaust gases, which are generally in excess of 400-500 ºC, are routed to a heat recovery steam generator (HRSG), where they are used to produce steam. In some cases, the exhaust gases can be used directly, eliminating the need for a HRSG. A bottoming cycle cogeneration system is one in which the fuel is first used for some thermal processes, with the exhaust gases being the by-product that is used to produce power. Most cogeneration systems utilize a topping cycle.

The basic argument in favour of a CHP is that it should be possible to obtain a worthwhile overall advantage by local generation of electricity, and at the same time make used of about two-thirds of the waste heat. Other specific benefits can be detailed as follows:

1. **Improved Albanian National Energy Efficiency and Preservation of Fossil Fuels Reserves (non-renewable energy)**
   As it is expressed on the Draft of Albanian National Energy Strategy, it is particularly important for Albania to reduce its dependence on imported fuels so as to improve the balance of payments. If Albanian production requirements are reduced then this will stimulate a competitive market for them. We should renounce from the individual electricity heating in each office, room (schools, hospitals and other public institutions) and consider the re-use of the central heating systems (or district heating for hospitals and boarding schools). When possible, the micro schemes of the combined production of electricity and thermal energy (CHP) will be used in order fit the needs of the service sector consumers. These schemes could also be successfully used in villages and in the existing and new tourist centres. The integrated schemes of solar panels (for hot water) with central and district heating and the CHP schemes are feasible from the energy efficiency and economical point of view.
2. **Local Generation of Electricity**

This will reduce the technical losses on transmission and distribution networks. This is with particularly interest for Albania since the losses in the transmission & distribution system are far to high at 1,230 GWh or 22 % of the net supply entering the system in 1999. These losses could be reduced by 50 % by rehabilitation of transmission, distribution networks and locally generation of electricity, which will increase the capacity of the system. Albanian Power Corporation, KESH, in close collaboration with ENEL have prepared an Investment Plan for reducing those losses, which will be implemented under World Bank package approved in April 2001.

3. **Reduction in Environmental Pollution**
   A reduction in the amount of pollution follows from the more efficient conversion of less fuel. Also, the more efficient use of exhaust gases in, say, a waste boiler (where, if supplementary firing take place, the fuels are more completely burned), will reduce pollution. More details about emissions from each scheme will be discussed in Section 4.15.
   In almost all the Western European Countries, most construction permits for medium and large cogeneration projects of a 5 MW or more will include a requirement for continuous emission monitoring for SO_2, NO_x and CO. Such monitoring can be costly, with system verification and recalibration costs significantly increasing cogeneration system operation costs. In some cases, where NO_x monitoring is required, a predictive monitoring consists of monitoring the actual operation of the emissions control system and the prime mover as a basis for computing emissions.
   In the most of Western European Countries, permits are limited to a term of five years and add an additional uncertainty to the project, as the permitting body can require the emission control system to be upgraded to requirements in effect at the time the permit is reissued. In addition, air quality decreases, the amount and cost of the offsets required for permitting will increase.
4. **Investment in Industry (more jobs) and Service Sector**
   Different strategies in different countries (Denmark, Holland, etc) has shown that by introducing CHP and District Heating (as well as Central Heating) more jobs will be created in the engineering, construction and service industries in municipal levels as well as in small service sector.

CHP is such an attractive proposition thermodynamically that many wonder why it is not used more widely in industrial, service and blocks of multi-storey buildings. As we will analyse in two Albanian case studies, the reasons are largely economic and relate to financial evaluation of capital investment. Detailed arguments are as follows:

- If an industry decided to invest in CHP plant then it is committed to a course of action and expenditure for a number of years. The financial appraisal of such a project involves a number of assumptions on the future energy demands of company, fuel prices and availability, taxes, discount rates, maintenance costs, which may be accurate only in the short term. It may be safer for a consumer simply to purchase the electricity from national grid and generate heat from its own boiler than to generate both of them from a CHP. This is one of the reasons that we have take under consideration in our option for supply electricity and heat to Student City.
- Any change in consumer behaviour may result in a later demand for more heat or power required more plant at a cost much higher than initial installation.
- Any change in consumer behaviour may result in a change in the balance of demand for heat and power. This point is covered in more details when will be analysed each option, but now we might say that will alter the overall efficiency of the plant and hence its economic viability.
- Any CHP plant design will include a provision for back-up, to ensure security of supply heat and electricity. Any support plant can only be regarded as spare capacity, which, by definition, will not be frequently used, and therefore will not be generating sufficient savings to offset the initial capital costs. Failure to include a back-up system, especially for a consumer as Student City, is an unacceptable risk.
- Apart from the capital costs of the prime power motor, there are large costs associated with the distribution of heat in pipelines. These costs may be a significant part of the initial investment unless the heat user is relatively near prime mover motor.
- Electricity demand and thermal energy demand are not at the same time, so it is very important to add a storage tank for thermal energy. This will increase first investment of energy supply scheme.

I.6 Heating and Cooling Map of Albania

I.6.1 Introduction to Heating, Cooling and Hot Water Energy Maps

The calculation of energy demand for heating, cooling and hot water carried out in detail and presented in Chapter 4 of this report serves as the main basis for the preparation of heating, cooling, hot water maps for 61 Municipalities of Albania. Consultant team prepared heating, cooling and hot water maps covering the entire Albanian territory at the municipality level , which, while preserving commercially sensitive information, identified:

- Heating and cooling demand for each municipality follows the analysis and all calculations carried out under chapter 4, while using consistent criteria for focusing on energy density parameter;
- Existing heating and cooling supply points identified district heating transmission installations;
- Planned heating and cooling supply points identified new areas for the district heating and cooling.

As a fundamental factor for estimating the energy consumption for heating, cooling and hot water for the residential and service sector, the number of families, residential areas, public and private services areas is used. This division is given for the year 2023 in Table I-37 based on the CENCUS 2023 carried out by INSTAT. The division into 3 sub-sectors was made on the basis of the average number of annual heating degree-days, on which the energy requirements for heating and to some extent also for hot water depend.

Table I-37: Distribution of municipalities according to climatic zones based on Heating Degree Days (HDD-^{0}C) concept and their respective territorial area

CLIMATIC ZONE 1 LOWER THAN 1300 HDD ^{0}C							
Nr	Municipality	Outside Design Temperature for Heating System, ^{0}C	Heating Degree Days (HDD-, ^{0}C)	Number Heating Days (Z)	Heating Season	Altitude above sea level, m	Total Municipality Area, km^2
1	Belsh	0	1250	135	15.XI – 29.III	190	194.44
2	Berat	0	1144	129	21.XI-29.III	226	379.98
3	Cerrik	-2	1277	137	17.XI-2.IV	80	189.56
4	Delvine	3	794	102	7.XII-18.III	15	189.90
5	Divjake	1	972	113	30.XI-23.III	9	309.58
6	Durres	1	995	116	1.XII-26.III	11	338.30
7	Elbasan	0	1144	126	22.XI-28.III	100	882.03
8	Fier	0	1208	139	18.XI-5.IV	12	629.90
9	Finiq	3	794	102	7.XII-18.III	13	441.20
10	Himare	4	715	96	18.XII-23.III	30	571.94
11	Kamez	0	1204	132	23.XI-3.IV	76	37.18
12	Kavaje	1	1072	123	26.XI-28.III	100	198.81
13	Konispol	3	794	102	7.XII-18.III	9	241.88
14	Kuçove	0	1205	131	19.XI-29.III	32	160.23
15	Kurbin	0	1144	129	21.XI-29.III	16	263.00
16	Lezhe	0	1190	125	25.XI-29.III	20	509.10
17	Lushnje	1	972	113	30.XI-23.III	19	392.72
18	Patos	0	1208	139	18.XI-5.IV	62	82.55
19	Peqin	0	1282	126	25.XI-30.III	53	197.79
20	Rroskovec	0	1110	129	20.XI-28.III	55	118.01
21	Rrogozhine	1	1072	123	26.XI-28.III	60	223.50
22	Sarande	5	650	88	15.XII-11.III	25	58.95
23	Selenice	0	1233	140	17.XI-5.IV	20	561.24
24	Shijak	1	1072	123	26.XI-28.III	70	91.19
25	Tirane	0	1132	126	22.XI-27.III	127	1130.03
26	Dimal/Ura Vajgurore	0	1110	129	20.XI-28.III	55	159.56
27	Vlore	3	794	102	7.XII-18.III	3	666.85

28	Vore	0	1132	126	22.XI-27.III	121	82.72
CLIMATIC ZONE 2, 1301-2300 HDD ^{0}C							
29	Dropull	-2	1479	144	13.XI-2.IV	163	458.25
30	Gjirokaster	-2	1479	144	13.XI-2.IV	193	469.25
31	Gramsh	-2	1312	140	13.XI-2.IV	200	759.22
32	Kelcyre	-2	1391	143	13.XI-4.IV	240	324.65
33	Klos	-3	1904	162	1.XI-11.IV	301	367.48
34	Kruje	-2	1516	159	13.XI-20.IV	560	359.02
35	Libohove	-2	1479	144	13.XI-2.IV	193	248.24
36	Librazhd	-2	1778	154	6.XI-8.IV	250	793.36
37	Malesi e Madhe	-3	1392	139	10.XI-29.III	48	951.01
38	Mallakastër	-3	1392	139	10.XI-29.III	49	337.00
39	Mat/Burrel	-3	1904	162	1.XI-11.IV	309	493.50
40	Memaliaj	-2	1429	147	11.XI-6.IV	28	372.07
41	Miredite	-10	2525	203	15.X-5.V	988	899.71
42	Permet	-2	1391	143	13.XI-4.IV	260	601.95
43	Pogradec	-7	2281	196	20.X-3.V	720	594.77
44	Polican	-2	1486	153	7.XI-8.IV	410	272.02
45	Prrenjas	-2	1778	154	6.XI-8.IV	270	322.95
46	Shkoder	-3	1392	139	10.XI-29.III	28	872.71
47	Skrapar/Çorovode	-2	1486	153	7.XI-8.IV	410	861.44
48	Tepelene	-2	1429	147	11.XI-6.IV	28	461.24
49	Vau i Dejes	-3	1392	139	10.XI-29.III	20	499.09
CLIMATIC ZONE 3 HIGHER THAN 2301 HDD ^{0}C							
50	Korce	-8	2606	199	14.X-30.IV	898	805.99
51	Devoll/Bilisht	-10	2588	205	12.X-4.V	890	459.27
52	Bulqize	-9	2532	203	14.X-4.V	655	688.51
53	Diber/Peshkopi	-10	2659	189	17.X-23.IV	657	947.88
54	Fushe-Arres	-10	3115	222	30.IX-20.V	1310	560.00
55	Has	-10	2640	208	11.X-6.V	817	399.62
56	Kolonje	-7	2366	192	21.X-2.V	920	846.06
57	Kukes	-9	2352	181	19.X-17.IV	255	983.86
58	Maliq	-10	2716	209	9.X-7.V	740	674.34
59	Puke	-10	2736	202	14.X-3.V	810	505.53
60	Pustec	-13	3422	245	25.IX-27.V	1143	198.68
61	Tropoje/B.Curri	-9	2366	182	19.X-19.IV	360	1057.30

Source: Data collected by EECG team based on the Energy Building Code, ex National Agency of Energy - 2003

Respective maps are prepared based on the data presented on table I-37 and all calculations carried out under chapter 4 and the respective details are presented at following sessions.

I.6.2 Heating Energy Maps

Consultant team have prepared the Heating Energy Maps based on following detail calculations:
Step 1: Calculating energy consumption for meeting heating energy demand for residential buildings, for each municipality, is based by breaking down the total space heating demand calculated on chapter 4 according to the number of families, total residential area, and respective heating degree days. The following formula is used for defined space heating energy demand for the residential sector for each municipality:

$$Energy_{Heat.}^{Res.Mun.(t)} = Energy_{Heat.}^{Res.Alb} * \frac{Sp.Spac.Heat._{Heat.}^{Clim.Zone-Res.Mun.(t)}}{WASp.Spac.Heat._{Heat.}^{Res.Alb}} * \frac{Area_{Resid.}^{Mun.(t)}}{Area_{Resid.}^{Alb.}} \quad (1)$$

Where:

$Energy_{Heat.}^{Res.Mun.(t)}$ - Space Heating calculated for the residential sector for each climatic zone (group of the respective municipalities (t) presented under table I-37).

$Energy_{Heat.}^{Res.Alb}$ – Total Space Heating Energy Demand was calculated and it is presented under chapter 4 for the residential sector for Albania.

$Sp.Spac.Heat._{Heat.}^{Clim.Zone-Res.Mun.(t)}$ – Specific Space Heating Energy for each climate zone for the respective municipality (t) presented under the table I-37.

$WASp.Spac.Heat._{Heat.}^{Alb}$ – Weighted Average Specific Space Heating (kWh/m^2*year) for Albania based on the residential areas for each municipality.

$Area_{Resid.}^{Mun.(t)}$ Total Area of the Residential Building Stock calculated and presented under chapter 4 for each municipality (t).

$Area_{Resid.}^{Alb.}$ – Total Area of the Residential Building Stock calculated and presented under chapter 4 for Albania.

Step 2: Calculating energy consumption for meeting heating energy demand for public buildings with the following formula for each municipality:

$$Energy_{Heat.}^{Pub.Mun.(t)} = Energy_{Heat.}^{Pub.Alb} * \frac{Sp.Spac.Heat._{Heat.}^{Clim.Zone-Pub.Mun.(t)}}{WASp.Spac.Heat._{Heat.}^{Pub.Alb}} * \frac{Area_{Pub.}^{Mun.(t)}}{Area_{Pub.}^{Alb.}} \quad (2)$$

Step 3: Calculating energy consumption for meeting heating energy demand for private and commercial service buildings with the following formula for each municipality:

$$Energy_{Heat.}^{Priv.Mun.(t)} = Energy_{Heat.}^{Priv.Alb} * \frac{Sp.Spac.Heat._{Heat.}^{Clim.Zone-Priv.Mun.(t)}}{WASp.Spac.Heat._{Heat.}^{Priv.Alb}} * \frac{Area_{Priv..}^{Mun.(t)}}{Area_{Priv.}^{Alb.}} \quad (3)$$

Step 4: Calculating energy consumption for meeting high temperature heat energy demand for industrial enterprises with the following formula for each municipality:

$$Energy_{High\,Temp.Heat.}^{Ind.Mun.(t)} = Energy_{High\,Temp.Heat.}^{Ind.Alb} * \frac{GDP_{Ind.}^{Mun.(t)}}{GDP_{Ind.}^{Alb.}} \quad (4)$$

Consultant team carried out final following **steps (5,6,7,8,9)** for calculating energy heating density for each sector and for each municipality with following formula. The respective results are presented at table I-38.

$$Energy\ Density_{Heat.}^{Res.Mun.(t)} = \frac{Energy_{Heat.}^{Res.Mun.(t)}}{Area_{teritorial}^{Mun.(t)}} \quad (5)$$

$$Energy\ Density_{Heat.}^{Pub.Mun.(t)} = \frac{Energy_{Heat.}^{Pub.Mun.(t)}}{Area_{teritorial}^{Mun.(t)}} \quad (6)$$

$$Energy\ Density_{Heat.}^{Priv.Mun.(t)} = \frac{Energy_{Heat.}^{Priv.Mun.(t)}}{Area_{teritorial}^{Mun.(t)}} \quad (7)$$

$$Energy\ Density_{High\,Temp.Heat.}^{Ind.Mun.(t)} = \frac{Energy_{High\,Temp.Heat.}^{Ind.Mun.(t)}}{Area_{teritorial}^{Mun.(t)}} \quad (8)$$

$$Energy\ Density_{Heat.}^{ALL.Mun.(t)} = Energy\ Density_{Heat.}^{Res.Mun.(t)} + Energy\ Density_{High\,Temp.Heat.}^{Ind.Mun.(t)} + \\ + Energy\ Density_{Heat.}^{Pub.Mun.(t)} + Energy\ Density_{Heat.}^{Priv.Mun.(t)} \quad (9)$$

Table I-38: Space heating density for each municipality

Nr	Municipality	Space heating energy density for Residential Sector, kWh/m^2	Space heating energy density for Public Service Sub- Sector, kWh/m^2	Space heating energy density for Private Service Sub- Sector, kWh/m^2	High Temp. heating energy density for Industry, kWh/m^2	Total Heating energy density for all sectors kWh/m^2
1	Belsh	85.86	8.05	18.68	60.38	172.97
2	Berat	154.30	14.46	75.40	243.76	487.92
3	Cerrik	125.06	11.72	17.46	56.43	210.67
4	Delvine	30.59	2.87	18.06	58.39	109.91

5	Divjake	75.72	7.10	16.95	54.78	154.55
6	Durres	427.80	40.10	94.71	306.18	868.79
7	Elbasan	122.94	11.52	32.48	105.01	271.96
8	Fier	152.50	14.29	50.10	161.95	378.85
9	Finiq	24.37	2.28	8.51	27.50	62.66
10	Himare	13.72	1.29	9.17	29.65	53.83
11	Kamez	2,436.07	228.32	336.47	1,087.70	4,088.57
12	Kavaje	142.22	13.33	45.87	148.30	349.72
13	Konispol	19.08	1.79	16.35	52.85	90.07
14	Kuçove	182.73	17.13	24.18	78.16	302.19
15	Kurbin	123.25	11.55	10.74	34.72	180.26
16	Lezhe	95.03	8.91	51.05	165.02	320.01
17	Lushnje	151.46	14.20	25.28	81.72	272.65
18	Patos	208.02	19.50	44.97	145.39	417.88
19	Peqin	78.97	7.40	14.28	46.17	146.83
20	Rroskovec	130.39	12.22	27.70	89.54	259.85
21	Rrogozhine	52.97	4.97	9.03	29.18	96.15
22	Sarande	361.40	33.87	130.07	420.46	945.80
23	Selenice	16.08	1.51	2.16	6.97	26.72
24	Shijak	227.89	21.36	57.53	185.97	492.75
25	Tirane	546.62	51.23	260.69	842.73	1,701.27
26	Dimal/Ura Vajgurore	182.08	17.07	11.38	36.79	247.32
27	Vlore	129.58	12.15	49.62	160.41	351.77
28	Vore	269.90	25.30	102.45	331.18	728.83
CLIMATIC ZONE 2, 1301-2300 HDD 0C						
29	Dropull	2.65	2.64	8.54	41.93	2.65
30	Gjirokaster	7.28	49.53	160.13	294.28	7.28
31	Gramsh	3.20	3.99	12.89	54.03	3.20
32	Kelcyre	1.99	2.86	9.24	35.23	1.99
33	Klos	4.86	4.06	13.13	73.71	4.86
34	Kruje	20.93	5.96	19.26	268.50	20.93
35	Libohove	1.63	3.25	10.51	32.77	1.63
36	Librazhd	4.31	5.09	16.44	71.66	4.31
37	Malesi e Madhe	3.35	2.67	8.64	50.22	3.35
38	Mallakastër	6.90	7.78	25.16	113.13	6.90
39	Mat/Burrel	5.18	12.27	39.65	112.09	5.18
40	Memaliaj	2.59	3.25	10.52	43.94	2.59
41	Miredite	2.22	3.01	9.71	38.56	2.22
42	Permet	1.95	2.88	9.32	34.82	1.95
43	Pogradec	11.37	16.28	52.64	201.08	11.37
44	Polican	4.73	7.86	25.42	88.24	4.73
45	Prrenjas	8.53	9.62	31.10	139.88	8.53
46	Shkoder	17.23	36.81	118.99	356.06	17.23
47	Skrapar/Çorovode	1.83	1.41	4.54	27.24	1.83
48	Tepelene	2.15	3.76	12.16	40.93	2.15
49	Vau i Dejes	5.66	5.42	17.51	88.78	5.66
CLIMATIC ZONE 3 HIGHER THAN 2301 HDD 0C						
50	Korce	16.93	37.65	121.72	359.32	16.93
51	Devoll/Bilisht	10.42	26.71	86.35	236.15	10.42
52	Bulqize	9.27	17.47	56.46	183.36	9.27
53	Diber/Peshkopi	12.03	24.44	79.00	245.53	12.03
54	Fushe-Arres	1.96	9.37	30.28	62.76	1.96
55	Has	6.57	7.07	22.85	107.48	6.57
56	Kolonje	2.00	3.91	12.64	40.13	2.00
57	Kukes	8.25	22.81	73.72	193.93	8.25
58	Maliq	10.93	9.46	30.57	169.17	10.93
59	Puke	2.93	7.10	22.97	64.64	2.93

60	Pustec	2.21	2.03	6.57	34.65	2.21
61	Tropoje/B.Curri	3.19	0.95	3.08	41.73	3.19

Source: Calculated by the Consultant

Analysis of values of space heating energy density for all sectors shows clearly that Kamza Municipality has the highest value equal to 2436 kWh/m2*year (or 2436 MWh/km2*year) much higher than the second value which belong to Tirana Municipality (equal to 546 kWh/m2*year (or 546 MWh/km2*year). Energy density for Kamza municipality is extremely high due to very small territorial area and very high-density buildings. Scales of the Space Heating Energy Density are based on the maximum (excluding Kamza values), average and minimum values as it is presented at the table I-39.

Table I-39: Defined scales for preparing the MAP of the Space Heating Density

Nr	Nominated scale	Total Space Heating energy density for all sectors, kWh/m2
1	MAX	1,701.27
2	AVERAGE	290.77
3	MIN	26.72
Defined scales for preparing the MAP of the Space Heating Density		
5	Very low	Lower than 50
6	Low	Between 51-120
7	Medium	Between 121-300
8	High	Between 301-550
9	Very high	Higher than 551

Source: Calculated by the Consultant

Figure I-89.1 presents the Map of the Space Heating Energy Density for each municipality of Albania and analysis shows clearly that Tirana, Korca, Kamza, Shkodra, Vora, Durres have the highest heating density among all other municipalities. Consultant team prepared also three more detailed Maps of the Space Heating Energy Density for three municipalities (within their territories) for Tirana (figure I-90), Shkodra (figure I-91) and Korca (figure I-92) Municipalities. Figure I-89.2 presents the Map of the Space Heating Energy Density and the potential heat extraction/recovery sites for each municipality of Albania.

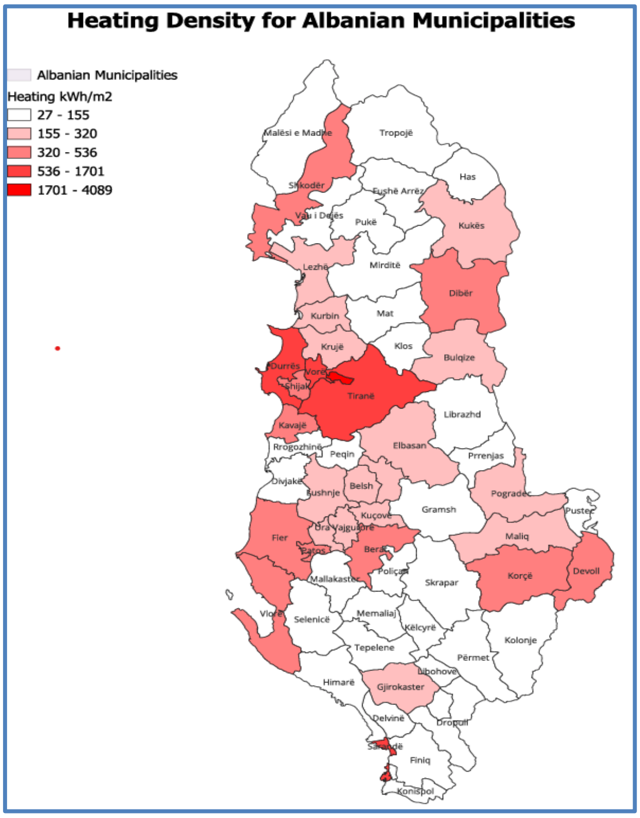


Figure I-89.1: Map of the Space Heating Energy Density for each municipality of Albania

Source: Calculated and prepared by the Consultant

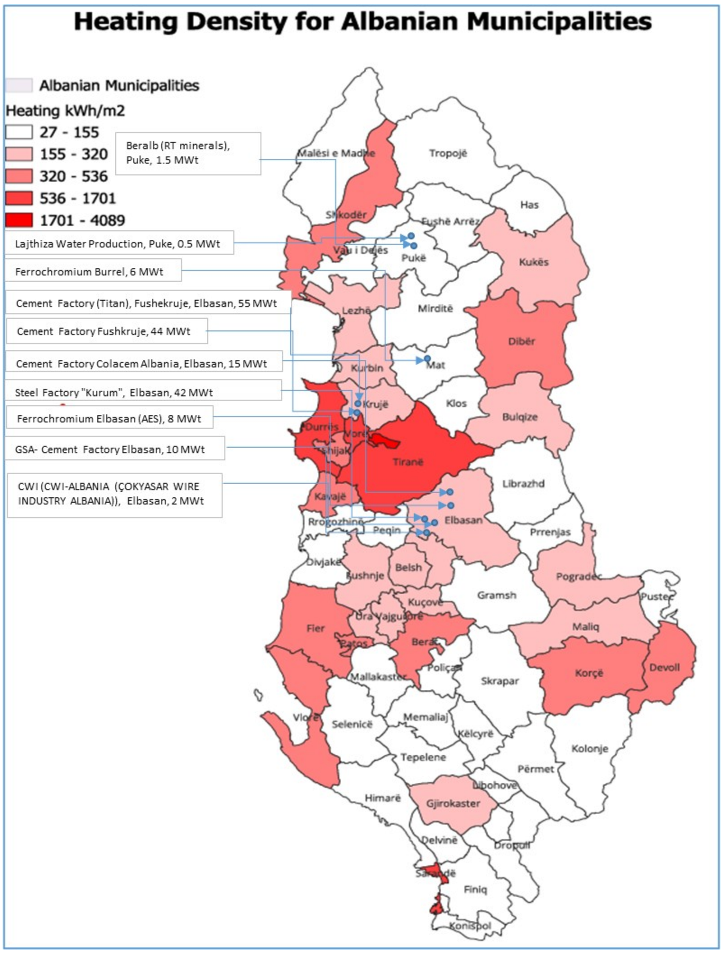


Figure I-89.2: Map of the Space Heating Energy Density and the potential heat extraction/recovery sites for each municipality of Albania.

Source: Calculated and prepared by the Consultant

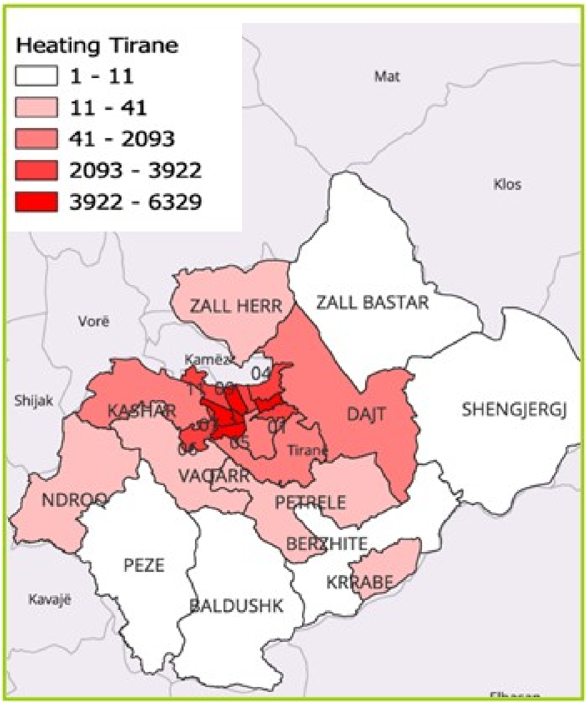


Figure I-90: Detail Map of the Space Heating Energy Density for Tirana municipality

Source: Calculated by the Consultant

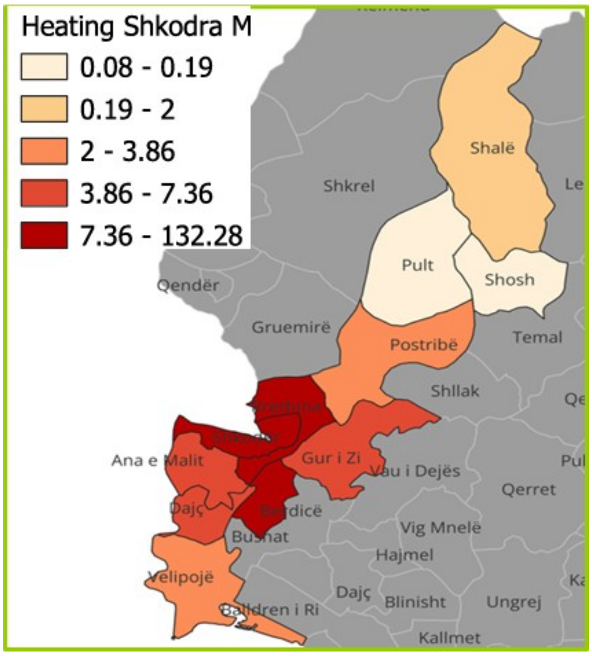


Figure I-91: Detail Map of the Space Heating Energy Density for Shkoder municipality
Source: Calculated by the Consultant

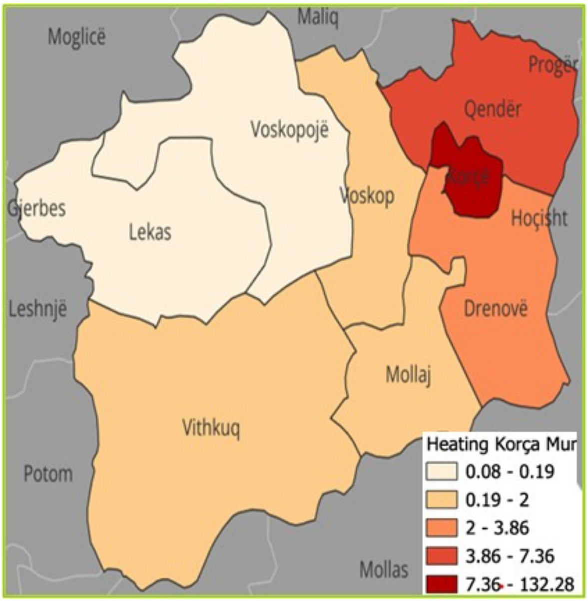


Figure I-92: Detail Map of the Space Heating Energy Density for Korca municipality
Source: Calculated by the Consultant

The map describing the figure I-89.2 presents the potential heat extraction/recovery sites for the industrial sites for potential waste heat recovery are identified. At the same time already Elbasan Incineration Plant is constructed without heat recovery system. Also, the Albanian Government has plans and it is the phase of the feasibility for incinerations of Tirana and Fier. Meanwhile, Albanian Government is in the process of updating the Solid Waste Management Action Plan for all District of Albania and final decision for the above-mentioned incinerations will be decided after detail feasibility studies. With respect to waste heat recovery, the assessed options relate to on-site recovery and heat recovery systems will involve direct utilisation to higher temperature levels and technologies are considered for on-site recovery.

I.6.3 Cooling Energy Maps

Consultant team have prepared the Cooling Energy Maps based on following detail calculations:

Step 1: Calculating energy consumption for meeting cooling energy demand for residential buildings, for each municipality, is based by breaking down the total space cooling demand calculated on chapter 4 according to the number of families, total residential area, and respective heating degree days. The following formula is used for defined space cooling energy demand for the residential sector for each municipality:

$$Energy_{Cool.}^{Res.Mun.(t)} = Energy_{Cool.}^{Res.Alb} * \frac{Sp.Spac.Cool._{Cool.}^{Clim.Zone-Res.Mun.(t)}}{WASp.Spac.Cool._{Cool.}^{Res.Alb}} * \frac{Area_{Resid.}^{Mun.(t)}}{Area_{Resid.}^{Alb.}} \quad (10)$$

Where:

$Energy_{Cool.}^{Res.Mun.(t)}$ - Space Cooling calculated for the residential sector for each climatic zone (group of the respective municipalities (t) presented under table I-40).

$Energy_{Cool.}^{Res.Alb}$ – Total Space Cooling Energy Demand was calculated and it is presented under chapter 4 for the residential sector for Albania.

$Sp.Spac.Cool._{Cool.}^{Clim.Zone-Res.Mun.(t)}$ – Specific Space Cooling Energy for each climate zone for the respective municipality (t) presented under the table I-40.

$WASp.Spac.Cool._{Cool}^{Alb}$ – Weighted Average Specific Space Cooling (kWh/m^2*year) for Albania based on the residential areas for each municipality.

$Area_{Resid.}^{Mun.(t)}$ Total Area of the Residential Building Stock calculated and presented under chapter 4 for each municipality (t).

$Area_{Resid.}^{Alb.}$ – Total Area of the Residential Building Stock calculated and presented under chapter 4 for Albania.

Step 2: Calculating energy consumption for meeting cooling energy demand for public buildings with the following formula for each municipality:

$$Energy_{Cool}^{Pub.Mun.(t)} = Energy_{Cool}^{Pub.Alb} * \frac{Sp.Spac.Cool._{Cool}^{Clim.Zone-Pub.Mun.(t)}}{WASp.Spac.Cool._{Cool}^{Pub.Alb}} * \frac{Area_{Pub.}^{Mun.(t)}}{Area_{Pub.}^{Alb.}} \quad (11)$$

Step 3: Calculating energy consumption for meeting cooling energy demand for private and commercial service buildings with the following formula for each municipality:

$$Energy_{Cool}^{Priv.Mun.(t)} = Energy_{Cool}^{Priv.Alb} * \frac{Sp.Spac.Cool._{Cool}^{Clim.Zone-Priv.Mun.(t)}}{WASp.Spac.Cool._{Cool}^{Priv.Alb}} * \frac{Area_{Priv..}^{Mun.(t)}}{Area_{Priv.}^{Alb.}} \quad (12)$$

Step 4: Calculating energy consumption for meeting cooling energy demand for industrial enterprises with the following formula for each municipality:

$$Energy_{Cool.}^{Ind.Mun.(t)} = Energy_{Cool.}^{Ind.Alb} * \frac{GDP_{Ind.}^{Mun.(t)}}{GDP_{Ind.}^{Alb.}} \quad (13)$$

Consultant team carried out final following **steps** for calculating energy cooling density for each sector and for each municipality with following formula. The respective results are presented at table I-40.

$$Energy\ Density_{Cool}^{Res.Mun.(t)} = \frac{Energy_{Cool}^{Res.Mun.(t)}}{Area_{teritorial}^{Mun.(t)}} \quad (14)$$

$$Energy\ Density_{Cool}^{Pub.Mun.(t)} = \frac{Energy_{Cool}^{Pub.Mun.(t)}}{Area_{teritorial}^{Mun.(t)}} \quad (15)$$

$$Energy\ Density_{Cool}^{Priv.Mun.(t)} = \frac{Energy_{Cool}^{Priv.Mun.(t)}}{Area_{teritorial}^{Mun.(t)}} \quad (16)$$

$$Energy\ Density_{Cool}^{Ind.Mun.(t)} = \frac{Energy_{Cool}^{Ind.Mun.(t)}}{Area_{teritorial}^{Mun.(t)}} \quad (17)$$

$$Energy\ Density_{Cool}^{ALL.Mun.(t)} = Energy\ Density_{Cool}^{Res.Mun.(t)} + Energy\ Density_{Cool}^{Ind.Mun.(t)} + \\ + Energy\ Density_{Cool}^{Pub.Mun.(t)} + Energy\ Density_{Cool}^{Priv.Mun.(t)} \quad (18)$$

Table I-40: Space cooling density for each municipality

Nr	Municipality	Space cooling energy density for Residential Sector, kWh/m²	Space cooling energy density for Public Service Sub- Sector, kWh/m²	Space cooling energy density for Private Service Sub- Sector, kWh/m²	Cooling energy density for Industry, kWh/m²	Total cooling energy density for all sectors kWh/m²
1	Belsh	26.00	1.63	3.62	21.80	33.16
2	Berat	46.72	2.93	14.60	87.99	72.00
3	Cerrik	37.87	2.38	3.38	20.37	45.42
4	Delvine	9.26	0.58	3.50	21.08	15.20
5	Divjake	22.93	1.44	3.28	19.77	29.39
6	Durres	129.53	8.13	18.34	110.52	165.73
7	Elbasan	37.22	2.34	6.29	37.91	49.19
8	Fier	46.17	2.90	9.70	58.46	63.92
9	Finiq	7.38	0.46	1.65	9.93	10.36
10	Himare	4.15	0.26	1.78	10.70	7.13
11	Kamez	737.58	46.27	65.14	392.64	883.59
12	Kavaje	43.06	2.70	8.88	53.53	59.36
13	Konispol	5.78	0.36	3.17	19.08	10.99
14	Kuçove	55.33	3.47	4.68	28.21	65.96
15	Kurbin	37.32	2.34	2.08	12.53	42.84
16	Lezhe	28.77	1.81	9.88	59.57	45.71
17	Lushnje	45.86	2.88	4.89	29.50	56.23
18	Patos	62.98	3.95	8.71	52.48	80.27
19	Peqin	23.91	1.50	2.77	16.67	29.65
20	Rroskovec	39.48	2.48	5.36	32.32	50.16
21	Rrogozhine	16.04	1.01	1.75	10.53	19.72
22	Sarande	109.42	6.86	25.18	151.78	154.84
23	Selenice	4.87	0.31	0.42	2.52	5.81
24	Shijak	69.00	4.33	11.14	67.13	90.38
25	Tirane	165.50	10.38	50.47	304.21	253.16
26	Dimal/Ura Vajgurore	55.13	3.46	2.20	13.28	61.96
27	Vlore	39.24	2.46	9.61	57.91	56.41
28	Vore	81.72	5.13	19.83	119.55	117.21
CLIMATIC ZONE 2, 1301-2300 HDD 0C						
29	Dropull	5.00	0.31	0.51	3.08	6.09
30	Gjirokaster	13.75	0.86	9.59	57.80	29.30
31	Gramsh	6.04	0.38	0.77	4.65	7.60
32	Kelcyre	3.76	0.24	0.55	3.34	4.84
33	Klos	9.19	0.58	0.79	4.74	10.97
34	Kruje	39.54	2.48	1.15	6.95	43.79
35	Libohove	3.09	0.19	0.63	3.79	4.25
36	Librazhd	8.15	0.51	0.98	5.94	10.17
37	Malesi e Madhe	6.32	0.40	0.52	3.12	7.51
38	Mallakastër	13.03	0.82	1.51	9.08	16.16
39	Mat/Burrel	9.78	0.61	2.37	14.31	14.03
40	Memaliaj	4.90	0.31	0.63	3.80	6.17
41	Miredite	4.20	0.26	0.58	3.51	5.35
42	Permet	3.68	0.23	0.56	3.36	4.76
43	Pogradec	21.48	1.35	3.15	19.00	27.65
44	Polican	8.93	0.56	1.52	9.18	11.82
45	Prrenjas	16.12	1.01	1.86	11.23	19.98
46	Shkoder	32.55	2.04	7.13	42.95	45.50
47	Skrapar/Çorovode	3.46	0.22	0.27	1.64	4.09
48	Tepelene	4.06	0.26	0.73	4.39	5.44
49	Vau i Dejes	10.70	0.67	1.05	6.32	12.98
CLIMATIC ZONE 3 HIGHER THAN 2301 HDD 0C						
50	Korce	14.15	0.89	7.29	43.94	26.20

51	Devoll/Bilisht	8.71	0.55	5.17	31.17	17.17
52	Bulqize	7.74	0.49	3.38	20.38	13.41
53	Diber/Peshkopi	10.05	0.63	4.73	28.52	17.93
54	Fushe-Arres	1.63	0.10	1.81	10.93	4.51
55	Has	5.49	0.34	1.37	8.25	7.93
56	Kolonje	1.67	0.10	0.76	4.56	2.93
57	Kukes	6.89	0.43	4.42	26.61	14.08
58	Maliq	9.14	0.57	1.83	11.03	12.51
59	Puke	2.45	0.15	1.38	8.29	4.71
60	Pustec	1.84	0.12	0.39	2.37	2.56
61	Tropoje/B.Curri	2.67	0.17	0.18	1.11	3.12

Source: Calculated by the Consultant

Analysis of values of space cooling energy density for all sectors shows clearly that Kamza Municipality has the highest value equal to 883 kWh/m2*year much higher than the second value which belong to Tirana Municipality (equal to 253 kWh/m2*year. Scales of the Space Cooling Energy Density are based on the maximum (excluding Kamza's values), average and minimum values as it is presented at the table I-41.

Table I-41: Defined scales for preparing the MAP of the Space Cooling Density

Nr	Nominated scale	Total Space Cooling energy density for all sectors, kWh/m2
1	MAX	253.16
2	AVERAGE	49.20
3	MIN	2.56
Defined scales for preparing the MAP of the Space Cooling Density		
5	Very low	Lower than 5
6	Low	Between 5.01-20
7	Medium	Between 20.01-50
8	High	Between 50.01-80
9	Very high	Higher than 80.01

Source: Calculated by the Consultant

Figure I-93 presents the Map of the Space Cooling Energy Density for each municipality of Albania and analysis shows clearly that Tirana, Korca, Kamza, Shkodra, Vora, Durres and other municipalities. Consultant team prepared also three more detailed Maps of the Space Cooling Energy Density for three municipalities (within their territories) for Tirana (figure I-94), Shkodra (figure I-95) and Korca (figure I-96) Municipalities.

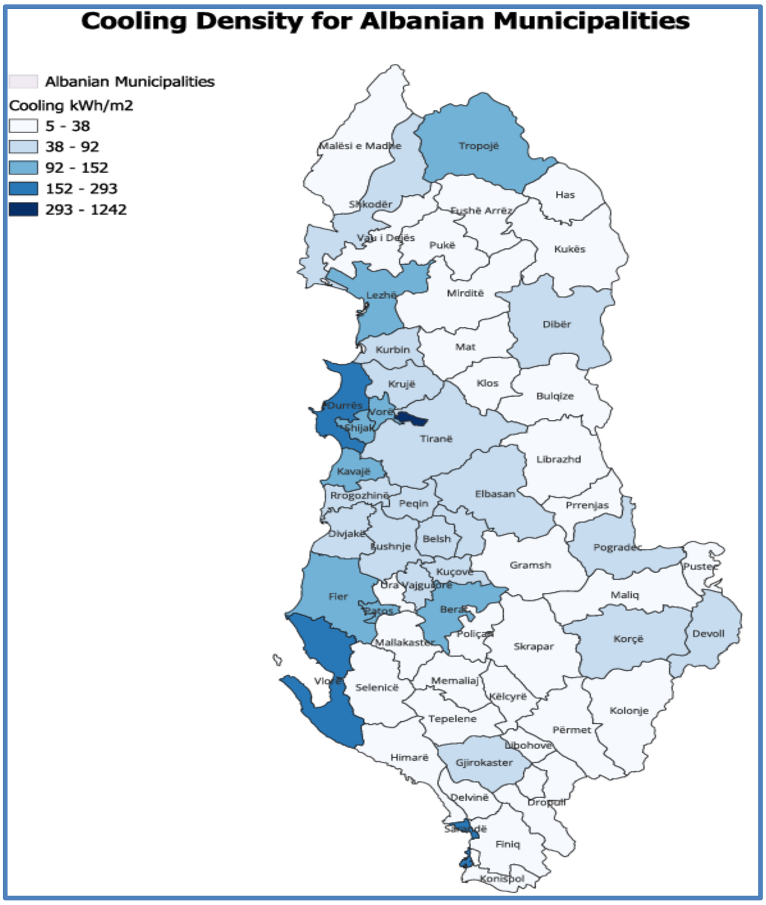


Figure I-93: Map of the Space Cooling Energy Density for each municipality of Albania
Source: Calculated by the Consultant

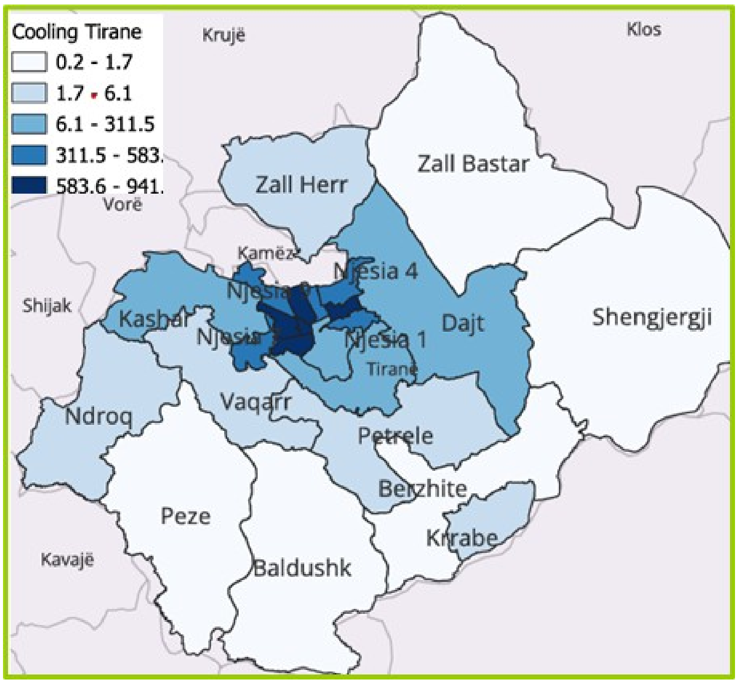


Figure I-94: Detail Map of the Space Cooling Energy Density for Tirana municipality
Source: Calculated by the Consultant

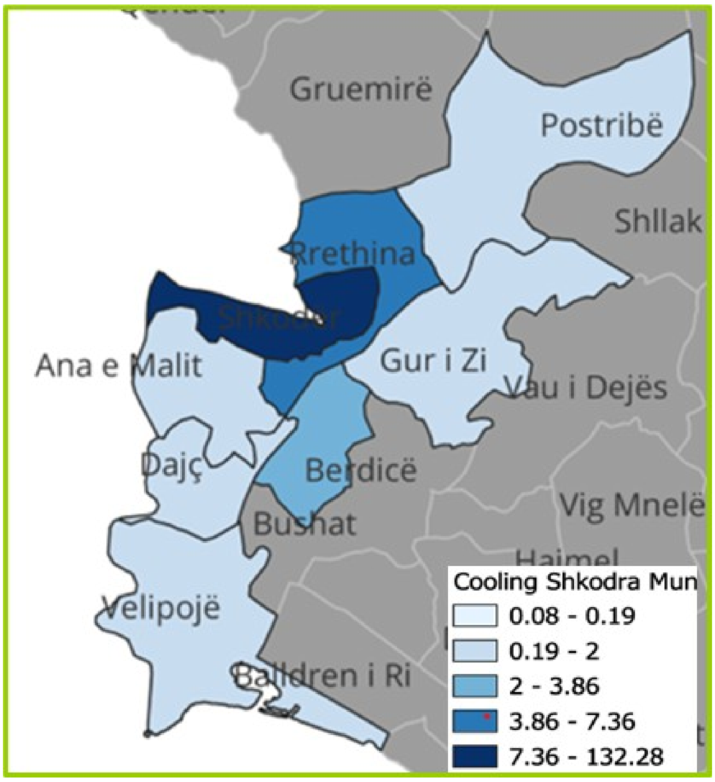


Figure I-95: Detail Map of the Space Cooling Energy Density for Shkoder municipality
Source: Calculated by the Consultant

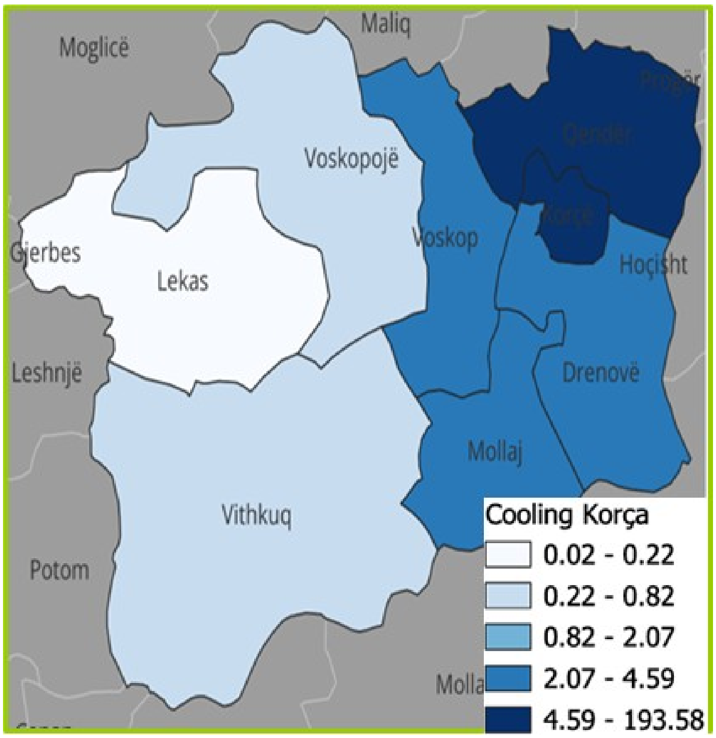


Figure I-96: Detail Map of the Space Cooling Energy Density for Korca municipality
Source: Calculated by the Consultant

I.6.4 Hot Water Energy Maps

Consultant team have prepared the Hot Water Energy Maps based on following detail calculations:
Step 1: Calculating energy consumption for meeting hot water energy demand for residential buildings, for each municipality, is based by breaking down the total hot water demand calculated on chapter 4 according to the number of families, total residential area, and respective number of persons per family.

The following formula is used for defined hot water (HW) energy demand for the residential sector for each municipality:

$$Energy_{HW}^{Res.Mun.(t)} = Energy_{HW}^{Res.Alb} * \frac{Sp.HW_{HW}^{Clim.Zone-Res.Mun.(t)}}{WAHW_{HW}^{Res.Alb}} * \frac{Area_{Resid.}^{Mun.(t)}}{Area_{Resid.}^{Alb.}} \quad (19)$$

Where:

$Energy_{HW}^{Res.Mun.(t)}$ - Hot Water calculated for the residential sector for each climatic zone (group of the respective municipalities (t) presented under table I-42).

$Energy_{HW}^{Res.Alb}$ – Total Hot Water Energy Demand was calculated and it is presented under chapter 4 for the residential sector for Albania.

$Sp.HW_{HW}^{Clim.Zone-Res.Mun.(t)}$ – Specific Hot Water Energy for each climate zone for the respective municipality (t) presented under the table I-42.

$WASp.HW._{HW.}^{Alb}$ – Weighted Average Specific Hot Water (kWh/m^2*year) for Albania based on the residential areas for each municipality.

$Area_{Resid.}^{Mun.(t)}$ Total Area of the Residential Building Stock calculated and presented under chapter 4 for each municipality (t).

$Area_{Resid.}^{Alb.}$ – Total Area of the Residential Building Stock calculated and presented under chapter 4 for Albania.

Step 2: Calculating energy consumption for meeting hot water demand for public buildings with the following formula for each municipality:

$$Energy_{HW.}^{Pub.Mun.(t)} = Energy_{HW.}^{Pub.Alb} * \frac{Sp.HW_{Heat.}^{Clim.Zone-Pub.Mun.(t)}}{WASp.HW._{Heat.}^{Pub.Alb}} * \frac{Area_{Pub.}^{Mun.(t)}}{Area_{Pub.}^{Alb.}} \quad (20)$$

Step 3: Calculating energy consumption for meeting hot water energy demand for private and commercial service buildings with the following formula for each municipality:

$$Energy_{HW}^{Priv.Mun.(t)} = Energy_{HW}^{Priv.Alb} * \frac{Sp.HW_{Heat.}^{Clim.Zone-Priv.Mun.(t)}}{WAHW_{Heat.}^{Priv.Alb}} * \frac{Area_{Priv..}^{Mun.(t)}}{Area_{Priv.}^{Alb.}} \quad (21)$$

Step 4: Calculating energy consumption for meeting low temperature heat energy demand for industrial enterprises with the following formula for each municipality:

$$Energy_{Low\ Temp.Heat.}^{Ind.Mun.(t)} = Energy_{Low\ Temp.Heat.}^{Ind.Alb} * \frac{GDP_{Ind.}^{Mun.(t)}}{GDP_{Ind.}^{Alb.}} \quad (22)$$

Consultant team carried out final following **steps** for calculating energy hot water density for each sector and for each municipality with following formula. The respective results are presented at table I-42.

$$Energy\ Density_{HW}^{Res.Mun.(t)} = \frac{Energy_{HW}^{Res.Mun.(t)}}{Area_{teritorial}^{Mun.(t)}} \quad (23)$$

$$Energy\ Density_{HW}^{Pub.Mun.(t)} = \frac{Energy_{HW}^{Pub.Mun.(t)}}{Area_{teritorial}^{Mun.(t)}} \quad (24)$$

$$Energy\ Density_{HW}^{Priv.Mun.(t)} = \frac{Energy_{HW}^{Priv.Mun.(t)}}{Area_{teritorial}^{Mun.(t)}} \quad (25)$$

$$Energy\ Density_{Low\ Temp.Heat.}^{Ind.Mun.(t)} = \frac{Energy_{Low\ Temp.Heat.}^{Ind.Mun.(t)}}{Area_{teritorial}^{Mun.(t)}} \quad (26)$$

$$Energy\ Density_{HW}^{ALL.Mun.(t)} = Energy\ Density_{HW}^{Res.Mun.(t)} + Energy\ Density_{Low\ Temp.Heat.}^{Ind.Mun.(t)} + \\ + Energy\ Density_{HW}^{Pub.Mun.(t)} + Energy\ Density_{HW}^{Priv.Mun.(t)} \quad (27)$$

Table I-42: Hot Water Energy density for each municipality

Nr	Municipality	Hot Water energy density for Residential Sector, kWh/m²	Hot Water energy density for Public Service Sub-Sector, kWh/m²	Hot Water energy density for Private Service Sub-Sector, kWh/m²	Low Temp. heating energy density for Industry, kWh/m²	Total Hot Water energy density for all sectors kWh/m²
1	Belsh	4.09	0.27	1.26	4.24	9.86
2	Berat	14.37	0.96	9.94	33.43	58.70
3	Cerrik	5.81	0.39	1.15	3.86	11.21
4	Delvine	1.42	0.09	1.19	4.00	6.71
5	Divjake	5.74	0.38	1.82	6.12	14.07
6	Durres	35.47	2.36	11.12	37.39	86.33
7	Elbasan	26.57	1.77	9.94	33.43	71.72
8	Fier	23.54	1.57	10.95	36.83	72.88
9	Finiq	2.63	0.18	1.30	4.38	8.49
10	Himare	1.92	0.13	1.82	6.12	9.99
11	Kamez	22.20	1.48	4.34	14.60	42.61
12	Kavaje	6.93	0.46	3.16	10.64	21.20
13	Konispol	1.13	0.08	1.37	4.61	7.19
14	Kuçove	7.17	0.48	1.34	4.52	13.52
15	Kurbin	7.94	0.53	0.98	3.30	12.75
16	Lezhe	11.86	0.79	9.02	30.33	51.99
17	Lushnje	14.58	0.97	3.44	11.58	30.57
18	Patos	4.21	0.28	1.29	4.33	10.11
19	Peqin	3.83	0.25	0.98	3.30	8.36
20	Rroskovec	3.77	0.25	1.13	3.81	8.97
21	Rrogozhine	2.90	0.19	0.70	2.35	6.15
22	Sarande	5.22	0.35	2.66	8.95	17.18
23	Selenice	2.21	0.15	0.42	1.41	4.19
24	Shijak	5.09	0.34	1.82	6.12	13.37
25	Tirane	151.37	10.07	102.22	343.77	607.42
26	Dimal/Ura Vajgurore	7.12	0.47	0.63	2.12	10.34
27	Vlore	21.18	1.41	11.48	38.61	72.68
28	Vore	5.47	0.36	2.94	9.89	18.66
	CLIMATIC ZONE 2, 1301-2300 HDD °C					
29	Dropull	3.16	0.21	0.42	1.41	5.20
30	Gjirokaster	8.89	0.59	8.07	27.12	44.68
31	Gramsh	6.32	0.42	1.05	3.53	11.32
32	Kelcyre	1.68	0.11	0.32	1.08	3.20
33	Klos	4.65	0.31	0.52	1.74	7.22
34	Kruje	19.56	1.31	0.74	2.50	24.11
35	Libohove	1.06	0.07	0.28	0.94	2.35
36	Librazhd	8.91	0.59	1.40	4.71	15.61
37	Malesi e Madhe	8.29	0.55	0.88	2.97	12.69
38	Mallakastër	6.05	0.40	0.91	3.06	10.43
39	Mat/Burrel	6.65	0.44	2.10	7.06	16.26
40	Memaliaj	2.51	0.17	0.42	1.41	4.51
41	Miredite	5.21	0.35	0.94	3.16	9.65
42	Permet	3.05	0.20	0.60	2.02	5.88

43	Pogradec	17.61	1.18	3.36	11.30	33.44
44	Polican	3.35	0.22	0.74	2.50	6.81
45	Prrenjas	7.17	0.48	1.08	3.63	12.36
46	Shkoder	39.15	2.61	11.15	37.48	90.39
47	Skrapar/Çorovode	4.11	0.27	0.42	1.41	6.22
48	Tepelene	2.58	0.17	0.60	2.02	5.38
49	Vau i Dejes	7.36	0.49	0.94	3.16	11.95
CLIMATIC ZONE 3 HIGHER THAN 2301 HDD ^{0}C						
50	Korce	36.15	2.37	10.53	35.41	84.46
51	Devoll/Bilisht	12.68	0.83	4.26	14.32	32.09
52	Bulqize	16.90	1.11	4.17	14.03	36.22
53	Diber/Peshkopi	30.21	1.98	8.04	27.03	67.26
54	Fushe-Arres	2.90	0.19	1.82	6.12	11.04
55	Has	6.95	0.46	0.98	3.30	11.69
56	Kolonje	4.47	0.29	1.15	3.86	9.78
57	Kukes	21.50	1.41	7.79	26.18	56.87
58	Maliq	19.54	1.28	2.21	7.44	30.47
59	Puke	3.92	0.26	1.25	4.19	9.61
60	Pustec	1.16	0.08	0.14	0.47	1.85
61	Tropoje/B.Curri	8.94	0.59	0.35	1.18	11.05

Source: Calculated by the Consultant

Analysis of values of hot water energy density for all sectors shows clearly that Kamza Municipality has the highest value equal to 1,146 kWh/m2 much higher than the second value which belong to Tirana Municipality (equal to 537 kWh/m2). Scales of the Hot Water Energy Density are based on the maximum (excluding Kamza's values), average and minimum values as it is presented at the table I-43.

Table I-43: Defined scales for preparing the MAP of the Hot Water Density

Nr	Nominated scale	Total Hot Water energy density for all sectors, kWh/m2
1	MAX	537.52
2	AVERAGE	85.30
3	MIN	7.21
Defined scales for preparing the MAP of the Hot Water Density		
5	Very low	Lower than 15
6	Low	Between 15.01-35
7	Medium	Between 35.01-80
8	High	Between 80.01-180
9	Very high	Higher than 180.01

Source: Calculated by the Consultant

Figure I-97 presents the Map of the Hot Water Energy Density for each municipality of Albania and analysis shows clearly that Tirana, Korca, Kamza, Shkodra, Vora, Durres and other municipalities. Consultant team prepared also three more detailed Maps of the Hot Water Energy Density for three municipalities (within their territories) for Tirana (figure I-98), Shkodra (figure I-99) and Korca (figure I-100) Municipalities.

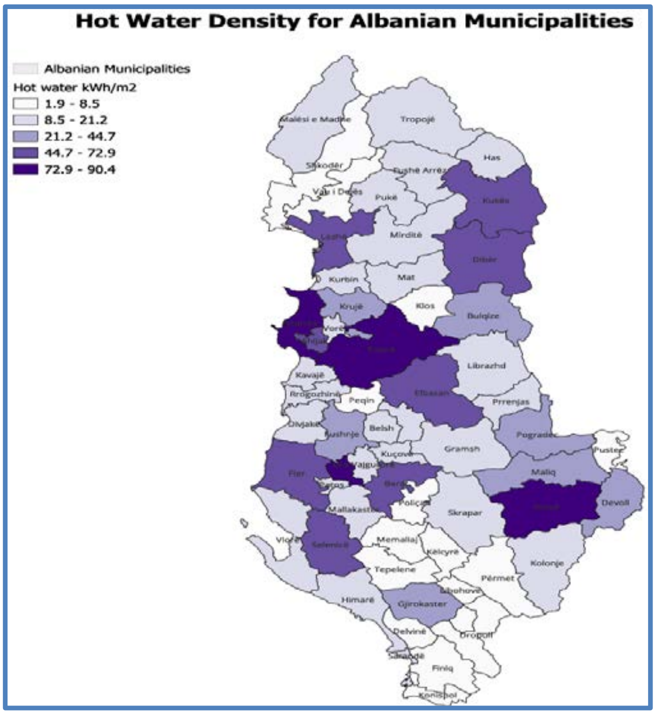


Figure I-97: Map of the Hot Water Energy Density for each municipality of Albania
Source: Calculated by the Consultant

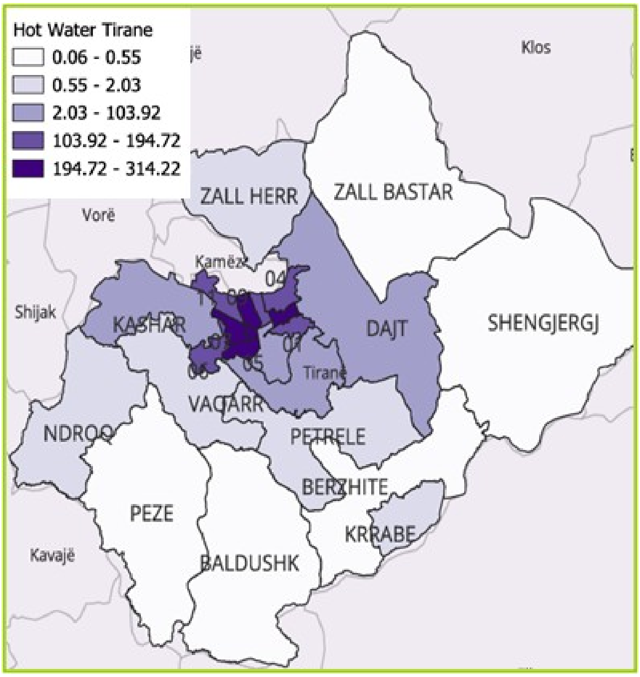


Figure I-98: Detail Map of the Hot Water Energy Density for Tirana municipality
Source: Calculated by the Consultant

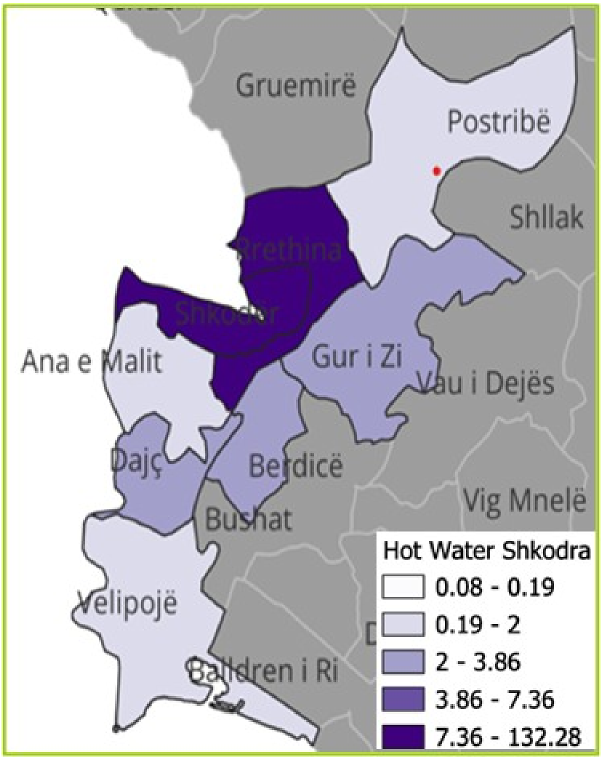


Figure I-99: Detail Map of the Hot Water Energy Density for Shkoder municipality
Source: Calculated by the Consultant

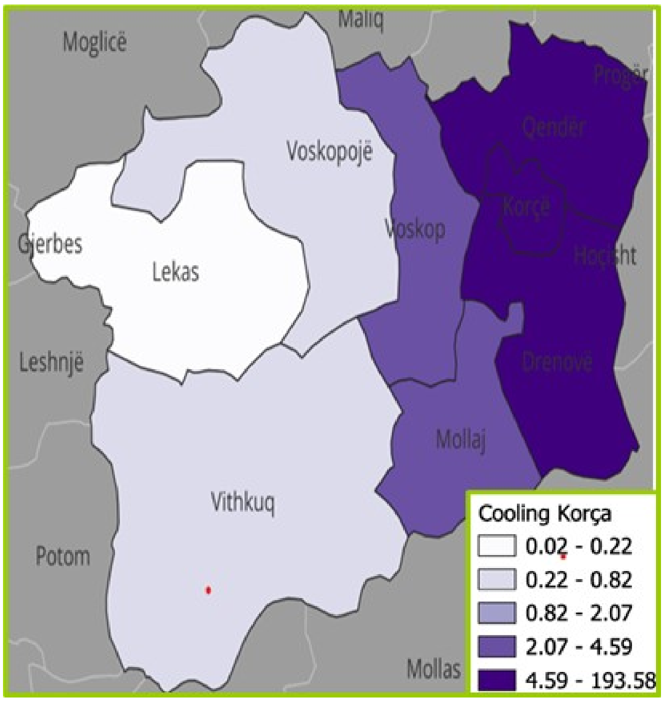


Figure I-100: Detail Map of the Hot Water Energy Density for Korca municipality
Source: Calculated by the Consultant

Part II - OBJECTIVES, STRATEGIES AND POLICY MEASURES

II.1 Overview of implemented and planned policies and measures

Article 2a of the Energy Performance of Buildings Directive (EPBD 2010/31/EU, as amended by decision 2021/14/MC of the Ministerial Council of the Energy Community) requires that Albania establishes a Long-Term Building Renovation Plan to improve the energy efficiency of the national stock of public, private and residential buildings in a cost-effective manner. EE Directive and EE Law also promote improvement of the investment for reducing energy efficiency for the industrial enterprises. Part II of this report presents in details the actual situation related to two main aspects:

3. Detail analysis of the existing barriers for implementing EE/RES measures for reducing space heating, cooling and hot water energy consumption for four important sectors analysed in Part I: residential, central & municipal public buildings, private services and commercial buildings as well as all industrial sub-sectors.
4. An overview of implemented and planned policies and measures for EE/RES measures for reducing space heating, cooling and hot water energy consumption.

Analysis of PART II is aligned (or goes beyond the relevant requirements) with the following national documents and laws:

- National Energy and Climate Action Plan;
- Law on EPB;
- National Strategy of Energy;
- Census 2023 (preliminary report September 2024);
- National Energy Balance, 2010-2023;
- Long Term Building Renovation Action Plan.

II.2 Market Barriers and Responsibilities

The results of the analysis presented in this session suggest that significant opportunities exist in Albania to use energy more efficiently for meeting space heating, cooling and hot water energy services. Efficiency in this context means providing an equivalent energy service at lower total cost (i.e., at lower combined energy operating costs and EE implementation costs).

This section summarizes some barriers to the implementation of EE/RES measures that are specific to the current situation in for meeting space heating, cooling and hot water energy services for residential, public buildings, private service buildings and industrial sector. The following analysis is focused on those barriers that can be influenced by interventions at the microeconomic level. That is, the barriers in question can be removed - or at least reduced - by taking specific remedial actions for which nominated individuals can be held responsible. Macroeconomic barriers, such as the income level, whilst constituting a potential obstacle to improvements in energy efficiency, cannot be eased by one or two specific actions and therefore lie outside the scope of this analysis.

II.2.1 Economic Barriers

Economic barriers are those impediments to EE/RES investments which can be attributed to the condition of the Albania economy, both in terms of wealth and in terms of its level of development. Included in this category are barriers caused by misplaced incentives and flaws in market structures.

II.2.2 Institutional Barriers

Institutional barriers are the result of inadequate or inappropriate organizational structures within the Albania EE/RES market, which prevent or hinder efficient decision-making and effective implementation of investment decisions. They also include ‘decisions influenced by custom tradition related to implementation of EE/RES for meeting space heating, cooling and hot water energy services.

II.2.3 Legal and Regulatory Barriers

Whilst the majority of legal and regulatory parts related to the EE/RES have been prepared by MIE in Albania there are still some secondary legislation and some technical regulation which need to be prepared and to be absorbed by residential, public buildings, private service buildings and industrial owners in order to mitigate the legal barriers to EE /RES, which is a necessary part of the legislative framework and has to be accepted and complied with, there are other laws and regulations that lead to perverse or incorrect outcomes and these may need to be modified or restructured in order to facilitate the implementation of EE /RES measures.

II.2.4 Financial Barriers

A financial barrier is one that imposes significant restrictions on capital availability for potential borrowers to invest for EE/RES measures for meeting space heating, cooling and hot water energy services in the residential, public buildings, private service buildings and industrial sectors. Economic theory predicts that for a risk-adjusted price, the market should provide capital for all investment needs. In practice, however, some potential borrowers, for example low-income individuals and small business owners of private service & commercial & industrial companies, are frequently unable to borrow at any price as the result of their economic status or credit-worthiness. This lack of access to capital inhibits EE/RES investments by such consumers.

II.3 Barriers for Implementing EE/RES measures in the Residential Sector

II.3.1 Economic (E) Barriers

Barrier RE1: Market distortions in local energy markets mean that the prices of some energy commodities do not reflect their true production/generation/transmission/distribution costs (e.g., firewood and partially also the electricity (especially for the residential sector). The main energy sources for both space and hot water for rural families in Albania are biomass - mainly firewood - and electricity, each accounting for around 50% and 35% of consumption (and LPG is the remaining one). In many households, fuel wood is less expensive (and more reliable) for space heating and hot water than electricity.

II.3.2 Institutional (I) Barriers

Barrier RI1: Many households adhere to traditional methods of space and water heating, either because of preference, lack of awareness or, in rural areas due to lower equivalent energy price and in rare cases for security of supply reasons. Especially, but not only, in rural areas, many households choose to use inefficient (and possibly unsafe) equipment because they feel comfortable with traditional practices, know how to extract the best results from them and have adapted their daily routine to fit in with the demands of such practices. However, although using wood for fuel may be the appropriate choice in certain circumstances, the principles of energy efficiency still apply in those circumstances - an efficient wood burning stove is always preferable versus to an inefficient one.

II.3.3 Legal and Regulatory (LR) Barriers

Barrier RLR1: Illegal houses and apartments. Legalization of illegal houses/apartment has been main objective of Government and the percentage is reduced from almost 55% in 2010 to 15% in 2024. The e-Albania system shall continue strongly to be used that ensures co-ordination EEA and municipal offices. It is also a prerequisite that all municipality staff dealing with building permits and procedures should be adequately trained and informed related to Energy Performance Certificate procedures and the respective energy report.

Barrier RLR2: There is no secondary legislation to promote the establishment of ‘owners’ communions’ (or Home Owners Associations) and current structures to deal with refurbishment of the building envelope of joint dwellings and ‘common areas’ in apartment blocks are ineffective. Important legislation related to the development and management of MABs and the key primary and secondary acts are:

- Law No. 10 112, dated 9.4.2009 on "Administration of co-ownership in residential buildings"

- Decision of the Council of Ministers, no. 447, dated 16.6.2010 on "Approval of the standard regulation for the administration of co-ownership in residential buildings"
- Decision of the Council of Ministers, no. 777, dated 24.9.2010 on "Approval of the rules for conducting the inspection, issues, methodology, frequencies and the manner of notification and procedures followed by the administrator for their implementation for MAB"
- Decision of the Council of Ministers, no. 1011, dated 10.12.2010 on "Approval of the standard format of the act of joint ownership for MAB"
- Administrative INSTRUCTION no.27, dated 20.12.2010 on "Calculation of the administration fee for residential buildings in joint ownership for MAB"
- Administrative INSTRUCTION no.4728, dated 7.11.2011 for the approval of the model contract for the administration of co-ownership for MAB

As mentioned above, the condominium law regulates ownership and limited real rights, possession, real security rights and real rights of use. These limited real rights may be created in ownership and in other suitable real rights. Ownership and other real rights can only be limited or taken away against the lawful holders' will in accordance with conditions and procedures as defined by the applicable laws. This law regulates the conditions and manner of sale of public and socially owned apartments where there is a tenure right or the rent right indefinitely, along with common parts and building equipment, as well as ways determining the selling price of the apartment and termination of tenure rights. This Law applies to socially owned apartments and public housing in which there is tenure right.

The legal base above-mentioned does not state that creation of the ‘owners’ communion**’** is compulsory or voluntary – it simply proposes a form of organization, but without the mechanisms or powers to enforce it. So, while the establishment of ‘owners’ communions’ or Housing Associations has been encouraged by the Government, the effort has been largely ineffective. This is because it requires individuals to devote time and effort to running such associations and it requires all tenants in a building to agree on what projects are needed and to contribute financially towards meeting the total cost of improvements (e.g., repairs or installation of EE measures). The diverse mix of occupants in many buildings means that not all residents have the same financial capabilities and cannot afford to make equal financial contributions to pay for repairs and improvements. As result, there are no housing associations to take up loans for improvements, proposed renovation work is never undertaken, the fabric of joint dwelling buildings deteriorates and potential savings remain unrealized.

Owners of apartment within MABs need to understand that the establishment of a Home Owner Association (HOA) would improve their living conditions by improving the MAB-envelope and communal areas within the property. An effective way of creating such an understanding would be to develop financial schemes to support the implementation of EE/RES measures during the refurbishment of a joint dwelling, but only if is specifically organized by a Home Owner Association or equivalent body. Both loans and grant schemes to reduce costs and help poorer tenants meet their financial obligations need to be made available. Thus, the linkage between the establishment of an HOA and some positive improvements in the living environment can be established in the occupants’ minds.

Barrier RLR3: (a) electricity and wood are not yet cost-reflective, (b) tariffs are subsidized and (c) some inefficient tariff structures persist. According to the ‘Rule on Public Electricity Supplier Pricing’ adopted by the Board of the ERE in, the Regulated Retail Tariff “shall reflect the costs of supplying different Customer Groups” and, *inter alia*, shall be set so as to “Reflect the costs of supplying different Customer Groups during different seasons and times of the day, to the extent allowed by limitations on customer metering”.

However, electricity tariffs for residential sector in Albania are still relatively low and cross-subsidized by other sectors (private services and industry). Electricity tariffs recover the costs of production, transmission and partly of distribution and billing, but not the cost of investment in the system that is needed to improve the security and quality of supply.

II.3.4 Financial Barriers

Barrier RF1: Lack of affordable EE financing schemes for lower income households unable to access the loan market. Clearly, the inability to get access to capital limits EE investments by such consumers. In principle, if a consumer takes a loan in order to purchase an energy-efficient equipment, its utilization should improve the borrower’s net cash flow - an important component of credit-worthiness - reduce the risk to the lender and consequently should reduce the interest rate.

GEEF/EBRD through ProCredit Bank and Union Bank are currently issuing loans with 15-20% grant versus loan amount after the verification of commissioning of the EE/RES measure is implemented. So, while there is a need for international banks to increase their credit lines with substantially lower interest rates to stimulate the EE market, the difficult part is to make the local commercial banks interested, since IFIs normally rely on the resources of local banks for loan disbursement. This situation creates a barrier to energy efficiency, because the commercial banks - for the time being not interested in utilizing the available credit lines - are blocking the more targeted energy saving loans that the IFIs are offering. The terms for the credit lines could be eased to compete more effectively with the banks own funds, in terms of lower interest rate and fewer bureaucratic requirements (and possibly accompanied by a guarantee scheme to the banks, so that the risk of non-payment is transferred to the donor).

Barrier RF2: Losses and non-payment of energy bills. In cases where consumers do not pay for their energy consumption, the incentive to undertake energy efficiency measures is absent, except as a by-product of measures to enhance comfort in buildings. Electricity commercial losses in Albania have been reduced as a result of various actions taken by Government and from 50% in 2015 have increased to 4% at 2024. Schemes to incentivize and reward 100% payment could be devised jointly by AEE and donor agencies, whereby good players are provided with assistance to implement EE/RES improvements in their homes.

II.4 Barriers for Implementing EE/RES measures in the Private (P) Business (including the Private and Commercial Sector as well as Industry Sectors)

II.4.1 Economic (E) Barriers

Barrier CE1: Limited market awareness: There is a lack of awareness among owners of SMEs (all Private Service and Commercial Buildings are commercially register as SME in Albania as well as industrial enterprises) about the benefits of EE and RES. This can make it difficult for SMEs to justify the investment and secure a return on their investment. So, it is important that SMEs to have access to reliable information about EE and RES technologies, available financing options, and successful case studies.

II.4.2 Legal and Regulatory (LR) Barriers

Barrier CLR1: Complex regulatory environment: The legal and regulatory framework surrounding EE and RES projects can be complex and difficult to navigate for SMEs. The application process for funding and permits can be slow and cumbersome, discouraging SMEs from pursuing EE and RES projects. So, it is important reconstruction permissions need to be simple and SMEs to have access to reliable information about steps to be undertaken in order to get quickly the reconstruction permission for installing EE and RES technologies.

Barrier CLR2: Fragmented market: The market for EE and RES technologies is fragmented and dominated by a small number of suppliers (related goods and services (equipment, materials, installation, repair, maintenance, energy auditing, commercial forestry, PV auto producer systems, central Heating Pumps, central AC, fuel efficient ovens, recycling, industrial waste heat and cold; waste incineration; high efficiency cogeneration; renewable energy sources, such as geothermal, solar thermal and biomass, other than those used for high efficiency cogeneration; heat pumps; reducing heat and cold losses from existing district networks; district heating and cooling; etc.. This can lead to limited competition and higher prices. On other way around, the fragmented nature of the private sector prevents the development of strong private-public partnerships. Although credit lines and funds are available from IFIs via the banks, SMEs show little interest in the opportunities available as business development is their primary concern.

Barrier CLR3: Lack of infrastructure: The lack of essential infrastructure, such as grid connection for PV Auto produces and other renewable energy installations, can hinder the implementation of EE and RES projects.

Barrier CLR4: Missing ESCO modality: The main benefit of ESCOs is that they finance EE investments, thus obviating the need for their clients to borrow up-front capital, as the ESCO recovers its costs by retaining a proportion of the client's energy savings that result from the EE investment undertaken. In the absence of ESCOs, energy consumers wishing to invest in EE have to borrow the necessary funds, which not all consumers are willing or able to do. ESCO companies often develop out of other types of businesses that operate in the EE sector, as they become more comfortable with

EE market. Hence to alleviate this barrier, it is necessary for the Government to create confidence in the future of this market. This requires the Government to take various proactive measures to demonstrate its commitment to EE, such as preparing and approving the secondary legislations and creating demand by funding investment programs, facilitating the development of affordable finance packages, removing legal barriers in areas such as public procurement (based on Life-Cycle Cost (LCC) methodology) and allowing credit for bids which deliver environmental benefits, allowing central governmental and municipalities to retain at least some of the energy savings they make, supporting the development of Monitoring and Verification programs and so on.

Barrier CLR5: Lack of collaboration: There is a lack of collaboration between government agencies, financial institutions, and stakeholders in the EE and RES sector, which can hinder the development of a supportive ecosystem for SMEs. MIE and EEA have started to establish such collaboration and it will be important to have regular forums (at least every six months) for EE/RES between all governmental, banks and private companies.

II.4.3 Financial (F) Barriers

Barrier CF1: High upfront costs: The initial investment required for EE and RES technologies (like PV Auto producers, Central Biomass Heating System, Central Heat Pump, etc) can be high, especially for smaller businesses with limited resources.

Barrier CF2: Limited access to financing: Local banks are hesitant to provide loans for EE and RES projects due to perceived risks associated with new technologies and long payback periods. This can be further compounded by high-interest rates and limited availability of collateral among SMEs (as private service and commercial buildings).

Barrier CF3: Lack of awareness about funding opportunities: SMEs may not be aware of existing grant programs, subsidies, and other financial instruments available to support EE and RES projects.

Barrier CF4: Inability to meet co-financing requirements: Commercial Banks and sometimes also many funding programs (EBRD, KFW, EIB, WB) require SMEs to contribute a certain percentage as equity contribution of the project cost, which can be a significant financial burden.

II.4.4 Technical (T) Barriers

Barrier CT1: Lack of technical expertise: SMEs may not have the in-house expertise to identify and evaluate suitable EE and RES technologies, design projects, carry out proper selection of EE/RES suppliers (by doing proper procurement and bidder selection) or manage implementation.

Barrier CT2: High level of transaction costs (in terms of both money and time) for EE/RES investments. This is a barrier that operates across all sectors, particularly where a new market is being established, where there are no established procedures, and the players tend to be risk averse. Transaction costs encompass the entire process of planning for, implementing and monitoring EE/RES investments. Transaction costs include the cost of obtaining an energy audit, preparing Detail Engineering Design, getting expert advice on the correct technical specifications, securing finance, preparing investment plans for the lender, verifying the purchase of equipment, implementing the measures, reporting on performance and so on. In the short-term the barriers can be eased by the main market participants taking actions to streamline processes and procedures, for example by offering comprehensive EE delivery mechanisms and programs, by providing standardized financing packages. In the medium-term the situation will naturally improve with time, as existing players become more confident and reduce risk premiums and new players enter the market and compete with the incumbents.

II.5 Barriers for Implementing EE/RES measures in the Central and Municipal Public (P) Sector

II.5.1 Economic (E) Barriers

Barrier PE1: Investment on EE/RES measures are not a top priority for administrators of central public buildings and for the municipality mayors of municipal public buildings - water supply, waste disposal, sewage treatment systems are considered more important. Municipalities are among the biggest consumers of energy in the public sector since they are responsible for municipal buildings, schools, health centers, cultural centers and kindergartens. Municipalities do not see EE /RES as their highest priority and any available funds are spent on other projects, for social or for political reasons, even though EE programs can have a better rate on return than other priorities. Since the administration of local government is a political process, decisions are in the hands of the mayors and various external constraints are encountered at the local level.

Barrier PE2: Lack of financial resources for programmatic EE investment projects. This will result in smaller number of EE rehabilitating public buildings.

Barrier PE3: Restrictive regulation that limits retainable energy cost savings, e.g., to use energy cost savings for energy efficiency investments. Public-building owners are not able to commit to long-term financial obligations. This will result in smaller number of EE rehabilitating public buildings.

Barrier PE4: Energy consumption for referent public buildings confirms that fuel/energy poverty is widespread especially in the municipality public building sector. Analysis carried out in the Long-Term Building Renovation Action Plan shows that for most of the public municipality public buildings the minimum comfort/living conditions (as required by the national standards) are not being met. This will result in smaller real energy saving (comparing the real consumption with EE/RES comfort scenario demand) compare with virtual energy savings (comparing the real consumption with baseline comfort scenario demand) and this will bring hesitation to carry out energy savings. Municipalities shall prepare the public building inventory and shall start introduction of EE/RES measures for those buildings which have higher consumption and year by year number of building with normal comfort consumption will increase, since number of buildings with energy poverty will be reduced.

II.5.2 Institutional (I) Barriers

Barrier PI1: Newly institution and lack of collaboration: EEA is newly established and it needs time to get all experiences, it is under resourced relative to its responsibilities and obligations related to different EE/RES financial mechanisms for public buildings. There is a general lack of institutional focus and commitment to save energy among all central and municipality public building institutions. Also, there is a weak inter-ministerial cooperation and coordination on energy efficiency targets, initiatives, projects and instruments. All above mentioned barriers will result in smaller number of EE/RES rehabilitating public buildings.

Barrier PI3: Poor institutional memory due to high staff fluctuation and a general lack of staff, as well as insufficient follow-up of failure of compliance with commitments and acts. Limited communication and exchange between governmental agencies, NGOs and market players (equipment and financing). Also, there is a weak donor coordination for improvement of public energy efficiency. All above mentioned barriers will result in smaller number of EE/RES rehabilitating public buildings.

Barrier PI3: Insufficient EE/RES expertise and resources at municipal level. There are 61 municipalities in Albania, 20 of them have a budget higher than €10m. in 2024. The demands of the EU integration, decentralization process is placing an increasing burden on municipalities, while their resources are not increase at such level to meet these new requirements.

Due to a lack of capacity, municipal energy and climate planning and implementation are constrained in several areas. In the first place, the Law on Energy Efficiency requires the establishment of municipal energy offices. The quantity and quality of energy planning resources in the smaller municipalities is not compatible with the work load being imposed on them. The SEMP/SECO (Smart Energy Municipality Project financed by Swiss SECO cooperation) project which started in June 2018 has established MEMU (Municipality Energy Management Unit) and prepared full scale MECAP (Municipality Energy and Climate Action Plan) municipal energy plans for up to 4 municipalities (Berat, Korce, Permet and Shkoder). This will leave the duty to municipalities in need of to establish MEMU-energy offices and prepare their respective MECAP. Secondly, there is a lack of municipal expertise in processing EE/RES projects related to the building applications. New buildings regulations are more complicated than earlier versions and training for municipal officers will be needed. Finally, in order to remedy the situation, municipal MEMU officers must be trained to process EE/RES building project applications and fully understand the new legal requirements. Upgrading of EEA staff might be necessary, as the workload will increase with the legalization of buildings without permits. Realistically, it should be acknowledged that energy planning and the preparation of MECAP plans in harmony with NECP and Long-Term Building Renovation Plan is only a practical option for the largest municipalities and that the smaller municipalities do not have the resources or the capacity to manage such specialist work. To realize economies of scale, energy and EE/RES planning should be carried out at a regional level, possibly employing the framework that has been developed by the EE Agency that addresses the problems encountered by the large number of small municipalities.

II.5.3 Legal and Regulatory (LR) Barriers

Barrier PLR1: Weak and fragmented market capacities for energy services. Absence of an energy efficiency lobby from market player side, e.g., a dedicated association of suppliers. Smaller number of EE rehabilitating public buildings due to fragmented market capacities and due to absence of lobby related to the EE/RES projects.

Barrier PLR2: High variability of quality and costs of equipment and service market due to Covid 19 and followed by the energy crises. Smaller number of EE rehabilitating public buildings due to high variability of quality and costs.

Barrier PLR3: Low quality of installation services due to missing requirements for procurement and supervision by contractors. Law on Public Procurement requires government tenders to take account of positive EE/RES related aspects. Tenders are evaluated purely on the basis of gross cost and the value of the energy saving potential of bids most of the time it is ignored. Restrictive procurement rules are biased towards lowest price procurement and do not reflect the full cost of ownership (i.e., lifecycle cost). This will result in smaller number of EE rehabilitating public buildings. Public procurement regulation does not enable to specify energy performance criteria for equipment and materials. This will result in a smaller number of EE rehabilitating public buildings.

Barrier PLR4: Inadequate data and institutional capacity to monitor, verify and evaluate the impact of EE/RES programs. Lack of impartial, detailed technical information concerning EE investments. Also, sometimes there is a lack of a comprehensive and reliable EE/RES data base and it related to poor quality of decision making leading to ineffective investments.

Barrier PLR5: Limited implementation of the Laws on Energy Performance of Buildings due to incomplete secondary legislation (e.g., energy performance monitoring and certification, which is actually in the moment of revision by MIE based on the KfW support) and missing some administrative acts to enforce primary legislation. Lack of instruments/platform for progress monitoring of implementing/enforcing the current energy savings legislation and programs (such as qualified inspection, program evaluation, etc.). This will result in smaller number of EE rehabilitating public buildings.

Barrier PLR6: Budgetary rules do not allow municipalities to benefit from any energy savings they achieve in the longer term – each year’s budget allocation is based on the previous year’s outturn. Budget Law needs to be modified to facilitate the repayment of EE/RES investment costs and savings to municipalities and that the budget setting process, currently based on the previous year’s costs, means that municipalities cannot benefit from EE/RES investments in the longer term - as is the case in Albania. This results in a reduced incentive to invest in EE/RES measures, as a result of these misplaced incentives. Misplaced incentives result from transactions where the economic benefits of EE/RES measures do not accrue to the individual or organization that is trying to save energy. In Albania this can describe various types of relationship, for example, under the current framework, public buildings in Albania are not able to retain any financial savings that they realize through EE measures in the longer term as their budget each year is set on the basis of the previous year’s outturn. Moreover, the inability to retain savings potentially complicates any contractual relationship with a future ESCO, which would want to be guaranteed access to a proportion of realized energy savings. The Ministry of Finance (MoF) should consider whether it would be beneficial for this constraint to be relaxed or restructured in order to encourage building managers to implement EE measures.

Barrier PLR7: DCM no. 537, dated 8.7.2020 on “Minimum Energy Performance Requirements of Buildings” sets minimum standards for heating levels in public buildings and all refurbished public buildings and refurbishing measures in Albania must comply with it. The implication of this Regulation is that EE/RES savings can only be made after the specified comfort levels have been achieved. The energy audits show that many of the audited public buildings are operating below their planned comfort levels and that achieving comfort levels may initially increase energy consumption and energy costs, even if accompanied by the implementation of EE measures. In respect of public buildings - and particularly the space heating systems they use - the thermal comfort level must be taken into account when considering improvements in energy performance and energy savings. Financial assistance schemes might be established specifically to help public buildings, such as schools, hospitals and clinics meet their obligations and deliver the levels of comfort needed.

Barrier PLR8: The Law on Public Procurement should ensure that the process for evaluating government tenders takes account of any EE/RES related benefits that a particular proposal will deliver. It had been proposed by the WB method of selection of the bidder shall be based on the LCC-Life Cycle Cost there should be a requirement for bidders to purchase equipment and vehicles based on lists of energy-efficient product specifications drawn up by the authorities and to carry out energy audits and implement the resulting EE related recommendations. However, this requirement is not being implemented because there is no secondary legislation (for approving LCC methodology) in place for its application. As a result, tenders are evaluated purely on the basis of gross cost and the value of the energy saving potential of bids which include an energy efficiency component is ignored. The secondary legislation required to implement the Public Procurement Law is approved, LCC shall be approved as the Public Procurement Agency (PPA) regulations, training for Contracting Authorities shall be carried out and enforced by the PPA as quickly as possible.

II.5.4 Financial (F) Barriers

Barrier PF1: Lack of funding for energy audits and detail engineering designs. The EEA needs funds to pay for any energy audits and detail engineering designs that will have to be performed for public buildings. Some potential EE projects will not progress beyond the initial identification phase.

Barrier PF2: The Law on Public Debt imposes various restrictions on central and especially municipalities' ability to borrow money. Low financial profitability of EE investments (high payback time) under consideration of current energy prices and by neglecting economic benefit at national scale. This will result in a smaller number of EE rehabilitating public buildings.

Barrier PF3: Restrictions on borrowing from commercial banks. Lenders unwilling to provide debt financing to public agencies; and Lenders' perception of high risk. This will result on not involvement of private banks to invest in EE.

Barrier PF4: The Law on Public Debt imposes various restrictions on municipalities' ability to borrow money. However, for those municipalities that meet the required standards, the legal and regulatory environment appears to be favorable to municipality lending. The defined set of relationships that fixes debt ceilings and the maximum annual debt service relative to the value of collected own source revenues and general grant is conservative and therefore positive from a banking perspective. Credit enhancements are liquid and easily enforceable in case of default and the procedures that a municipality must follow in case of default are rigid. Municipalities may not incur debt unless in the previous two years that they have received unqualified audit opinions from the Office of the Auditor General as part of the mandatory annual audits. The requirement for two years of unqualified audits is appropriate, since it means that a lender can be confident of the accuracy of the financial information that is presented. However, last year only 10 municipalities, met this condition, which means that the majority of cash strapped municipalities are unable to borrow money in order to finance EE/RES (or other) projects. In the short- to medium-term, therefore, mechanisms should be developed that will channel funds to municipalities in other ways, for example through central government, via appropriate ministries.

Barrier PF5. Central government budgetary constraints prevent direct finance of EE projects. The necessary budget discipline to overall public finance prevents government of Albania to provide funds for direct investments in energy efficiency and especially creation of the energy efficiency fund. From a macro point of view, this is understandable, but on the other hand energy efficiency projects will suffer from this and a positive long-term effect will be lost. Therefore, Government of Albania could approach international donors especially IFIs and try to organize international support for creation of an energy efficiency fund or support to some of the grant elements, which have been described in this section. The position of Albania will be stronger if all ministries are involved, including MIE, MoF, EEA and the Albanian Development Fund.

II.6 Cross (X) Sectorial Barriers

II.6.1 Economic Barriers

Barrier XE1: Underdeveloped local EE/RES business infrastructure.

Residential building owners, Central and Public Building Administrators and SMEs owners in Albania tend to operate individually and there are not many any trade or representative organizations. They focus on taking advantage of immediate opportunities and do not to work within the framework developed by the municipality, NGOs and international donors, except on an ad hoc basis when there is a perceived need. The fragmented nature of the private sector prevents the development of strong private-public partnerships. Although credit lines and funds are available from IFIs via the banks, SMEs show little interest in the opportunities available as business development is their primary concern. Awareness of EE is not sufficient to make it a high priority and the commercial sector has only taken up less than 20% of the loans available for EE/RES projects.

This barrier results in the lack of a transparent and competitive EE market, with good quality (and preferably local) suppliers of EE related goods and services (equipment, materials, installation, repair, maintenance, energy auditing, commercial forestry, PV Auto producers, AC central heating systems, Heat Pump Systems, fuel efficient ovens, recycling, etc.) In Albania the EE industry is only slowly developing and does not yet display the characteristics associated with a vibrant and dynamic market. The enhancement of commercial and professional expertise to implement EE measures should be encouraged by the EEA and the Chambers of Industry and Commerce to support local businesses in identifying and developing EE market capabilities. EEA shall establish an EE/RES forum at which SMEs can discuss EE/RES and other related issues should be established. The forum could offer training in energy management and disseminate examples of best practice. Targeted campaigns could be launched, underlining the economic benefits of EE measures for small businesses and a website with good practice examples developed.

Barrier XE2: Absence of ESCOs and ESCO based schemes from the local market

The main benefit of ESCOs is that they finance EE/RES investments, thus obviating the need for their clients to borrow up-front capital, as the ESCO recovers its costs by retaining a proportion of the client's energy savings that result from the EE investment undertaken. In the absence of ESCOs, energy consumers wishing to invest in EE/RES have to borrow the necessary funds, which not all consumers are willing or able to do. ESCO companies often develop out of other types of businesses that operate in the EE/RES sector, as they become more comfortable with EE/RES market. Hence to alleviate this barrier, it is necessary for the Government to create confidence in the future of this market. This requires the Government to take various proactive measures to demonstrate its commitment to EE/RES, such as creating demand by funding investment programs, facilitating the development of affordable finance packages, removing legal barriers in areas such as public procurement (where life cycle cost methodology of selection of bidders have to be preferred) and allowing credit for bids which deliver environmental benefits, allowing municipalities to retain at least some of the energy savings they make, supporting the development of Monitoring and Verification programs and so on.

II.6.2 Institutional Barriers

Barrier XI1: Inadequate data and institutional capacity to monitor evaluate and verify the impact of EE/RES programs. Once a decision has been made to invest in specific EE/RES measures, there is a requirement to ensure that they are implemented correctly and then to monitor their performance. At present, the level of monitoring is inadequate and it is difficult to evaluate and verify the impact of the investments - and to use such information for evaluating the effectiveness of future investments. The commercial banks do undertake a degree of monitoring of the results of their 'EE/RES loans under EBRD/GEFF', but the data is not being centrally collected and analyzed. One of the tasks of the municipal energy offices is to follow up on the implementation of the NECP/MECAPs and to analyze the link between the overall action plan and detailed consumption at local level. In addition to monitoring the impact of major investments, procedures need to be put in place to identify and monitor the results of EE//RES measures undertaken privately by individuals and organizations, independently of any official schemes or programs. Technical assistance for EEA and municipal energy offices to develop expertise in monitoring and evaluation needs to be put in place as a matter of urgency is important.

Barrier XI2:

- Lack of impartial and detailed technical information on EE/RES markets and the goods and services they provide.
- Lack of surveys on the quality of EE/RES services and products means that potential customers are not well positioned to make informed decisions.

In order for the EE/RES market to work well, participants must be fully informed about current and future turn-key unit prices for different EE/RES measures including future energy commodities prices - technological options and developments and all other factors that might influence the economics of a particular investment. Clearly, these conditions can never be fully met in the energy services market and a number of significant information failures can be identified as inhibiting investments in energy efficiency: (1) the lack of information, (2) the cost of information, (3) the accuracy of information, and (4) the ability to use or act upon information.

The solutions could include local market surveys relating to building equipment, materials and services, and information on building materials explaining legal requirements could be published as a catalogue and on the web, with FQAs and most common solutions. Such catalogues have been developed in lately by the Government of Albania and it is accessible via e-Albania. Responsibility for its regular yearly update could rest with EEA in cooperation with PPA. Information should also be made available for the municipal energy offices. In Denmark, for example, an information office has been established at the Technological Institute for training professionals in how to carry out installation work. It shall consist of a section with 3-4 officials and the work of training different professionals for proper installation is tendered out by the EE Agency. A website is operational with information and examples on how to implement energy efficient measures.

Barrier XI3: Lack of donor coordination on EE/RES issues

In recent years there have been a number of separate EE/RES projects in Albania covering similar activities and with similar objectives. There have been examples of replication of effort (different projects audited the same buildings), confusion among the beneficiaries as to the status of and relationship between projects, a lack of sharing of data in a national EE data base and disruptive competition for funding. The establishment of a regular EE/RES forum and EE/RES monitoring platform for all interested parties would help to reduce the impact of this significant barrier.

II.6.3 Legal and Regulatory Barriers

Barrier XLR1: Law on Energy Performance in Buildings approved by Parliament (June 2025) laid down procedures for setting up an EE fund to promote EE and RES projects. EE/RES measures often require investments with a payback period that is longer than many consumers find acceptable. EE fund shall provide subsidies for implementing EE/RES investments, shortening the payback period and helping to provide access to below-market rate financing where necessary. Often such funds operate with energy audits integrated for the client. The experiences of other countries (e.g., Kosovo, Croatia, Greece, Latvia) suggest that EE funds are a very effective mechanism for driving forward EE/RES investments. Part IV analysis the actual situation related to the possible EE/RES Financial Mechanisms proposed for EE/RES investment in the different market segments like residential, public, private, commercial buildings as well as industrial enterprises.

II.6.4 Financial Barriers

Barrier XF1: High level of transaction costs for (in terms of both money and time) for EE/RES investments. This is a barrier that operates across all sectors, particularly where a new market is being established, where there are no established procedures and the players tend to be risk averse. Transaction costs encompass the entire process of planning for, implementing and monitoring EE/RES investments. Transaction costs include the cost of obtaining an energy audits and detail engineering designs, getting expert advice on the correct technical specifications, securing finance, preparing investment plans for the lender, selection of bidder/s, verifying the purchase of equipment, implementing the measures, reporting on performance and so on. In the short-term the barriers can be eased by the main market participants taking actions to streamline processes and procedures, for example by offering comprehensive EE/RES delivery mechanisms and programs, by providing standardized financing packages, by combining smaller projects (such as household and apartment block renovations) in one contract and so on. In the medium-term the situation will naturally improve with time, as existing players become more confident and reduce risk premiums and new players enter the market and compete with the incumbents.

II.7 Existing Policy for Heating, Hot Water and Cooling for all Sectors

II.7.1 Existing measures and efforts on the residential buildings

The Albanian government has made strides in offering grants and incentives aimed at fostering energy efficiency in the residential buildings sector through MIE/AEE grating at the first and second phases

Solar Hot Water Systems (SHWS) for 4,000 families (2000 families for each phase). These grants offer financial support for the acquisition of SHWS up to 90% of total purchased value.

For the last 6 years, the Municipality of Tirana has been implementing a Community Fund to retrofit the building envelopes of more than 180 MABs. The retrofit of another 17 MABs are in the planning and construction process, for the year 2025 based on the information received from Tirana Municipality.

The Agency for Energy Efficiency is implementing a pilot project targeting the renovation of:

- Five existing multi-family buildings identified by the Municipality of Tepelene;
- Three existing multi-family buildings identified by the Municipality of Korçë;
- 4-6 existing multi-family buildings identified by each municipality of Shkodër, Malesia e Madhe, Kurbin, Kukës, Has, Lezhë, Puke, Vau i Deja's, Klos, Fushë Arrë, Mat, and Bulqizë;
- 3-8 existing multi-family buildings identified by each municipality of Dibër, Tropojë, Krujë, Durrës and Rrogozhinë Municipalities.

GEFF/EBRD signed credit lines of approximately 20 million EUR with three local partner financial institutions, Pro Credit Bank, Union Bank and micro-financial institutions, as part of a larger 85 million EUR GEFF program operating in the Western Balkans with main focus on issuing loans for families for introducing EE/RES measures for rehabilitation of their houses. The grants are from 15% up to 20% of the total loan value, provided post successful implementation and verification of EE/RES measures.

Albanian citizens are investing their own money or also through commercial loans and loan products via banks (almost all banks in Albania have under their retail portfolio home rehabilitation products) for carrying out the rehabilitation or purchase of new apartments.

Albania faced a number of challenges in implementing the measures contained in the NECP. Many of the measures required the cooperation of government ministries and other entities outside of the Ministry of Energy and Industry (MEI). However, cross-ministerial understanding, coordination and thus buy-in for the plan was lacking, preventing integration of the measures within broader sector plans. Furthermore, some measures were unrealistic in the timescales proposed and did not undergo a detailed impact assessment.

A large number of pilot projects for residential building refurbishments were conducted, there was some training for energy auditors and managers, and with the support of international financing institutes (IFIs) and donors, domestic banks provided credit lines for energy efficiency measures, primarily for improving building envelopes, as previously stated.

II.7.2 Existing measures and efforts on the Central and Municipal Public Buildings

Despite the above difficulties, some progress on EE in Albania was achieved by carrying out different investment related to improvement of EE/RES for meeting space heating, water heating and cooling for the central and municipal public buildings sector. A formal evaluation of the energy savings achieved from the above measures has been hindered by the absence of a monitoring and verification platform. Some energy efficiency projects are under development/implementation, as described by AEE are as following:

- The Project "Development of a Financing Mechanism for Energy Efficient Public Buildings in Albania" was financed by the World Bank (2017-2018). The objective of this activity is to inform and facilitate decision-making for sustainable financing mechanisms for energy efficiency (EE) in the public buildings sector.
- Smart Energy Municipalities is a project financed by the SECO/Switzerland (2018-Nov 2025). The objective of this bilateral Project is to support selected Albanian municipalities to manage energy in a sustainable manner and to implement the national energy policy at local level. To this end, it will pilot and institutionalize an energy management system that is based on the European Energy Award (EEA) and incorporates the requirements of the national energy legislation. The Project contributes to improve energy management, reduce energy consumption, to mitigate climate change and to promote sustainable economic development.
- Study and Expert Fund measure on "Energy Management in Municipalities" by Germany/GIZ, strengthen partner capacities in energy efficiency and to plan, prioritize and implement selective energy efficiency measures at the municipal level in 12 municipalities (2021-2024).

- Regional Program: “ORF Energy Efficiency" by GIZ. The relevant political and civil society actors in South-eastern Europe increasingly take advantage of regional networks for the implementation of EU standards in the field of climate protection (2012-2021).
- Interreg IPA II Cross-border Cooperation Program Greece-Albania 2014-2020. The objective of the project is the implementation of small-scale NZEB (nearly zero energy buildings) investments and the development of a joint approach towards public NZEBs through smart initiatives and the establishment and operation of energy communities in the eligible area. This project is being implemented in the municipality of Gjirokastra and includes the reconstruction of the Cultural Center "Fato Berberi", significantly improving the energy efficiency of the building and turning it into a building with consumption close to zero energy.
- Extension of the Community Fund for the Implementation of EE/RES measures for meeting regulatory minimum energy performance requirements as well as NZEB standards for the MAB Stock for Central and Municipality building stock is recommended.

II.7.3 Existing measures and efforts on the Private Service and Commercial Buildings as well as in industrial enterprises

The private sector (composed by the private service and commercial buildings as well as in industrial enterprises) is strongly investing in EE/RES measures for improvements of their building stock with the support of international financing institutes (IFIs) and donors, as well as domestic banks providing credit lines for EE/RES measures, primarily for improving building envelopes as well as introducing of PV Autoproducers as roof top electricity generation systems.

An appropriate MRV system for tracking emissions needs to be in place, as foreseen in the adopted “Law on Climate Change” and DCM no. 889, dated 27.12.2022 for the approval of the regulation for monitoring, reporting of greenhouse gas emissions and other information related to climate changes at the national level. This decision defines in detail all economic sectors, including the calculation methods of emissions from the residential sector, private services, public services, industrial enterprises, emissions from the transport and agricultural sectors.

However, it is worth noting that the implementation of DCM no. 889, dated 27.12.2022 is in its early stages and the National Environment Agency is responsible for all sectors for all greenhouse gases. The Energy Efficiency Agency, based on the EE Law, is the technical institution which should implement the MRV system covering all sectors related to energy consumption, including the three sectors: residential, public buildings and private and commercial services. Council of Ministers Decision from 17 July 2024 approved the DCM for “Determination of the percentage of the public buildings stock area to be renovated each year compared with the total area of the public buildings stock”. It is important to be mentioned that it is directly also focused with the establishment of the MRV Systems for public building stock.

The purpose of this decision is to determine the percentage of the area of the public buildings stock to be renovated every year, compared to the total area of the public buildings stock as well as establishment of MRV Systems for public building stock. With the entry into force of this decision, the public sector is charged with the implementation of the objective, defined according to point 1, article 9/4, of law no. 124/2015, "On energy efficiency", as amended with main aspects: 3% of total central building stock (calculated versus total area) shall be renovated every year; and 2% of total municipal building stock (calculated versus total area) shall be renovated every year.

The renovations that will be carried out by the institutions shall guarantee at least the implementation of the minimum energy performance requirements, according to decision no. 537, dated 8.7.2020, of the Council of Ministers, "For approval of the minimum energy performance requirements of buildings and building elements"[7].

II.8 Policy Measures Foreseen under NECP for Heating and Cooling for all Sectors

[7] Each renovation is carried out based on the results of the energy audit, which must be accompanied by a separate cost-benefit analysis for each building that qualifies. Buildings which have a low energy performance and are used to house sick children or elderly people have priority in carrying out the renovations even when the optimal cost criterion is not met.

The National Strategy of Energy (approved in August 2018) represents a synthesis of detailed energy sector analysis (including all sectors: residential, service sectors (including municipal and central public buildings), transport, industry, and other sectoral and cross-sectoral strategic and planning documents, much of which was incorporated into an analytical review of future development pathways for Albania's energy sector. The principles guiding the development of this strategy are fully in line with the principles of the EU National Strategy for Development and Integration, and their goals are to:

- Increase the security of energy supply while ensuring sustainable development and providing affordable energy costs for Albanian citizens and the economy;
- Increase energy efficiency in all sectors: residential, public and private service sectors and industry with focus on improvement of EE/RES for meeting their heating, cooling and hot water energy demand;
- Further diversification of supply sources and interconnection with the regional and European electricity and gas networks;
- Establish a competitive and organized market that provides correct signals for production and consumption of electricity and natural gas, considering the specific influence of climate changes on the domestic power production;
- Couple the electricity market in line with the commitments made under the so-called Berlin process[8];
- Ensure that the climate change targets are met, including the renewable energy resource (RES) and energy efficiency targets.

Scenarios presented at the National Strategy of Energy dealing with the energy demand forecast (ktoe) for the residential, central and municipality public buildings sector in Albania (according to the National Strategy of Energy 2017-2030) and indicates increasing energy demand for the sector of almost 2.5 times on the year 2030 compare to 2014 in order to fulfil the respective energy services requirements according to the comfort parameters required. National Strategy of Energy is presenting the energy Savings potential (expressed in ktoe) by introducing the most important financial feasible EE measures (thermal insulation of envelope, efficient windows, efficient heating system, solar hot water systems, efficient lighting, efficient equipment, etc.) for the Residential, Central and Municipality Public Buildings in Albania (according to the National Strategy of Energy 2017-2030) and analysis shows clearly that energy saving potential will be about 50-56% for the year 2030 versus baseline scenario.

Albania has committed to prepare its first NECP during the year 2020, approved with the Decision of Council of Ministers No. 872 of 29.12.2021 "On the approval of the National Energy and Climate Plan 2020 – 2030" that complements the Energy Strategy, which draws up an integrated policy framework to steer decarbonisation efforts until 2030 and beyond, aligning with the goals of the European Green Deal. The National Energy and Climate Plan (NECP) has been recently undergoing additional revisions and will be amended by November/December 2025 with the main to harmonize with the recommendations of the Energy Community Secretariat (EnCS) on NECP improvement and to accommodate new 2030 objectives. The NECP revision process to address EnCS recommendations was initiated in April-September 2025, which has been undergoing further revision during 2024, supported by GIZ's technical assistance, to align with the new goals of 2030 set by the Energy Community Ministerial Council based on the Decision of the Ministerial Council of the Energy Community No 2022/02/MC-EnC, of 15 December 2022, regarding the reduction of greenhouse gases (GHG), the share of renewable energies and energy efficiency, respectively for final energy consumption and primary energy consumption.

Albania's National Energy and Climate revised Plan addressed the five dimensions in an integrated way, for determining the national goals. The five dimensions of the Energy Union are: (i) energy security; (ii) the internal energy market; (iii) energy efficiency (iv) decarbonization; and (v) research, innovation and competitiveness. The NECP provides targets and following main measures/programmes for the 5

[8] The Berlin Process is a diplomatic initiative linked to the future enlargement of the European Union. The Berlin Process is an intergovernmental cooperation initiative aimed at revitalizing the multilateral ties between the Western Balkans and selected EU member states, and at improving regional cooperation in the Western Balkans on the issues of infrastructural and economic development.

dimensions including EE/RES targets for the residential, service and industry sectors. Consultant has summarised all measures (Table II-1) and presented under NECP directly or indirectly related to EE/RES measures for improvements of EE/RES for improvement of heating, cooling, hot water energy demand for all above mentioned sectors.

Table II-1: Overview of EE/RES policies and measures included in the NECP

Nr.	NECP code	Policies and measures title	Type
1	EE-I3	Implementation of minimum energy performance standards for existing and new buildings	Legislative
2	EE-L6	Energy renovation programme for occupied residential buildings	Legislative / Financing / Investment
3	EE-L4, EE-L5 and EE-L7	Energy renovation programme for public (central and municipal) buildings	Legislative / Financing / Investment
4	EE-I1	Inspection of Building Technical Systems	Legislative; Technical
5	EE-O1	Energy efficiency obligation scheme and alternative measures for Albania	Legislative
6	EE-S1	Uptake of ESCO models	Legislative
7	EE-P2	Alignment of Municipalities Energy and Climate Action Plans with the BRP	Legislative
8	R-E11	Municipal Heat Maps	Legislative
9	G-B1	Policies to support RES in Heating and Cooling Sector	Legislative
10	EE-P1	Exemplary role of public sector	Legislative

Source: Summery of NECP

All above mentioned EE/RES policies and measures included in NECP are mentioned in the above-mentioned document and not elaborated in details. So, each of the above stated EE/RES policies and measures and additional added from the consulting team with much more details are presented and elaborated in the Part IV of the report. Among other details, the descriptions contain budget estimates that are intended to provide orientation for the detailed planning of all EE/RES measures. The up-front transaction costs/enabling environment soft investments, are also calculated and determined (presented under Part IV), i.e., implementation programmes, technical studies, promotional activities, technical assistance, trainings, development of guidelines/instructions, etc., which are necessary to make an investment successful in terms of achieving the objectives of a policy and measure.

Part III - ANALYSIS OF THE ECONOMIC POTENTIAL FOR EFFICIENCY IN HEATING AND COOLING

III.1 Analysis of the Economic Potential of Different Heating and Cooling Technologies

After defining and forecasting the trends in useful heat delivered and needed for heating and cooling, to analyse the economic potential of different heating and cooling technologies, it is necessary to do the following in order:

- Calculate the average and maximum heating/cooling loads;
- Calculate the peak load for the heat source (DHS);
- Define the technical criteria necessary for heat network connection (distance limits, consumption density);
- Determine the technical potential according to the baseline BAU scenario by proposing measures at the local level, as well as at the level of individual systems;
- Analyse costs and benefits for each proposed measure separately.

This chapter considers four sectors (households, public services, private services and industry) and determines the following types of loads for each of them:

- Average heating load for heating;
- Peak (maximum) heating load for heating;
- Average cooling load for space cooling;
- Peak (maximum) cooling load for space cooling.

These loads, which have been calculated using the formulae proposed by the European Commission: i) in household and service sectors, the term heating includes space heating and DHW preparation, while the term cooling refers to space cooling only; ii) in the industrial sector, the term heating includes space heating and DHW preparation (lower temperature heating), as well as higher temperature heating preparation for industrial processes, while the term cooling includes space cooling and cooling for industrial processes.

The total maximum heating load for heating in household, service and industrial sectors in Albania is 2768 MW, with the total maximum cooling load for cooling purposes in those sectors standing at 369 MW. When it comes to heating, the largest share of the total maximum heating load is accounted for by the household sector, followed by the service sector and the industrial sector. In terms of cooling, the residential sector has the largest share in the maximum cooling load, followed by the private sector (15.10%) and the industrial sector (table III-1).

Table III-1: Total maximum and average loads for heating and cooling in household, service and industrial (for the year 2023)

Sector	I. Industrial Enterprises	II. Residential Buildings	III. Public Service Buildings	IV. Private & Commercial Service Buildings	TOTAL Four Sectors
Maximum load capacity, MW					
Heating	**1158.16**	**1170.30**	**105.23**	**334.28**	**2767.97**
Cooling	**27.06**	**265.72**	**16.67**	**59.46**	**368.91**
Average load capacity, MW					
Heating	**701.91**	**709.27**	**63.78**	**202.59**	**1677.56**
Cooling	**16.40**	**161.04**	**10.10**	**36.04**	**223.58**

Source: Consultant's calculation

III.2 Defining Technical Criteria Necessary for Heat Network Connection

In order to assess the technical potential for heating and cooling efficiency, the following criteria have been applied:

- Heat density (maps prepared under Part I) – annual useful heating/cooling energy needs per unit area of the territory under observations;
- Population density of the municipality in which the heat source (waste heat, geothermal springs)

is located;

- Average and maximum load of the municipality in which the heat source is located;
- Available amount and power of waste heat of an installation or a geothermal spring;
- Distance of an area from its supply points (waste heat, geothermal energy) – observed only for the areas at a distance of less than 5 km.

The assessment of technical potential is based purely on technical aspects with the main aim of obtaining the theoretical maximum amount of energy that could be generated through efficient heating and cooling systems. An economic assessment will be conducted later to determine which part of the technical potential can economically be met by the proposed efficient solutions for heating and cooling. There is a number of solutions for efficient heating and cooling which could meet the identified useful thermal energy needs for heating and cooling. Generally speaking, a solution for heating and cooling efficiency is a combination of the following three elements: i) energy source (e.g., biomass, solar energy, electricity, waste heat); ii) the technology used to convert the energy source into a form of energy useful for the consumer (e.g., efficient boilers, heat pumps, solar hot water systems and heat recovery); and iii) distribution system delivering the useful energy to the consumer (centralised or decentralised).

Technical solutions, or measures for efficient heating and cooling proposed in the Comprehensive Assessment, are divided into measures relating to: i) decentralised (individual) systems – each consumer has their own separate source of heating and cooling energy; and ii) centralised systems – district heating and cooling systems distributing heat from the source to the consumer. Energy efficiency measures for district heating systems include:

➢ Constructing new efficient district heating systems;

➢ Using renewable energy sources (biomass, solar collectors) as main fuel for new efficient district heating systems;

➢ Applying biomass and natural gas as back up fuel for high-efficiency cogeneration;

➢ Using geothermal energy sources in the possible financially feasible place;

➢ Utilisation of waste heat from industrial installations in the possible financially feasible place;

➢ Energy-from-waste especially from methane recovery from landfills;

➢ Using a heat-carrying medium in the summer to power the central absorption chiller for cooling spaces in larger non-residential buildings (e.g., hospitals, hotels, shops, etc.).

When it comes to waste heat from existing industrial installations and the heat available from biomass energy sources, solar energy, geothermal energy sources, their distance from the closest existing district heating system was taken into account first, with the use of available thermal energy within a distance of less than 5 km from the customers sites. District heating systems will deliver heat to all four sectors observed (households, public services, private services and industry).

Therefore, boilers fired by fossil fuels (mainly natural gas, with fuel oil still used as well) are the most common type of generation installation technology in the existing systems.

The BAU scenario for 2030 and 2050 forecasts a slight decrease in diesel, coal and heavy fuel boilers, a complete decommission of fuel oil boilers by 2040, a decline in natural gas cogeneration and an increase in the use of solar, biomass and geothermal energy, and biomass and natural gas high-efficiency cogeneration. Decarbonisation scenario measures for 2030 and 2050 foresees the following:

- Complete decommissioning of fuel oil boilers (by 2040);
- Use of heat from thermal waste treatment (significant potential in densely populated urban areas) – the figure shows electricity used as drive energy and heat taken from the environment;
- Use of solar energy (small portion);
- Increase in biomass high-efficiency cogeneration;
- Starting to use geothermal energy in the possible financially feasible place;
- Use of water-to-water compression heat pumps;
- Use of industrial waste heat (small portion in the possible financially feasible place).

Between 2023 and 2050, the proposed measures would ensure a reduction in CO2 emissions from new district heating and CHP systems including final and primary energy savings are presented in details in the following Part IV of this report.

Today, Albania has not any district heating and CHP systems and does not have any designed for high temperatures in distribution networks. This implies that new district heating and CHP systems to be planned as modern generation installations, access to new sources of renewable energy, efficient distribution infrastructure, highly efficient buildings renovated for low-temperature thermal energy supply, and as well as designed and planned with improved control of the heating system and heat metering with charging based on the actual consumption. European Parliament **on energy efficiency** (EED) includes the following definition: **efficient district heating and cooling** – a district heating or cooling system using at least 50% renewable energy, 50% waste heat, 75% cogenerated heat or 50% of a combination of such energy and heat.

Energy efficiency measures for district heating systems will include construction of new primary and secondary district heating networks, installation of new boilers using biomass and natural gas as back up boilers, installation of new heat pumps, utilisation of solar water systems with heat pumps, construction of new high- efficiency combined-cycle cogeneration plants, the use of waste heat from industrial installations, utilisation of new geothermal energy with new heat pumps, and heat from waste incineration plants. The proposed measures are presented in more detail in the table below. The required thermal capacity of the source that needs to be installed, as well as the annual savings in delivered energy and CO_2 emissions after the implementation of the measures have been calculated and presented for each measure under Part IV of this report. These DH systems will be installed in areas with very high heat density with large population, concentrated public and commercial building as well as closer to industrial areas (Table III-2).

Table III-2: ALL New Efficient DH & CHP plant

No.	Type of DH system (installed capacity expressed in MW)	2023	2030	2040	2050
1	New DH systems with new efficient boilers using biomass	0	84.61	94.06	103.71
2	New DH systems with new heat pumps	0	14.10	21.50	24.68
3	New DH systems with utilisation of solar water systems with heat pumps	0	28.20	33.85	72.60
4	New DH systems with construction of new high- efficiency combined-cycle cogeneration plants	0	0	82.84	246.08
5	New DH systems with the use of waste heat from industrial installations	0	11.28	21.50	41.48
6	New DH systems with utilisation of new geothermal energy with new heat pumps	0	0	5	10
7	New DH systems with the use of waste heat from industrial installations	0	2.82	10	20
	TOTAL DH & CHP plant	**0**	**141.0**	**268.7**	**518.5**

Source: Consultant's calculation

Total investment is estimated at around 385 million Euro and will be secured from State Budget, private investors with support from the European Regional Development Fund through the Operational Fund for Competitiveness and Cohesion.

Sources of industrial waste heat constitute possible thermal energy potential which could be utilised in new district heating systems. That potential depends significantly on the characteristics of the observed industrial sectors and depends on fuels, conversions and process characteristics even in the industrial production of the same product.

The analysis of heat generated in industry has at least two dimensions – the distinction between industrial sectors or production processes, and that between the energy products used. In order to determine the amount of usable waste heat from different industrial processes, the analysis based on the energy products used first distinguishes between electricity and energy products for heat generation. Although electricity is also used in certain processes for heat generation, waste heat generated in the process typically has no usable potential, so this energy product is omitted. Thus, the possible heat generation energy products are the following: i) conventional fossil fuels: natural gas, extra light and special fuel oil, high-sulphur fuel oil, low- sulphur fuel oil, diesel fuels other than for transport, petrol other than for transport, liquefied gas hard coal and its briquettes, brown coal and its briquettes, coke (metallurgical, foundry and petroleum); ii) future energy transformation: steam and water at temperatures lower than or equal to 200°C; steam and water at temperatures higher than 200°C; iii) biomass: firewood, wood pellets and chips, wood and plant waste; iv) fuels from residues: waste oils and emulsions, old tyres, and others.

By breaking down the important factors at the given level and taking into account the most common types of energy use, the following sources are considered for their considerable potential for utilising industrial waste heat: i) transformed forms of energy – steam and hot water, separately for temperatures lower than or equal to 200°C and higher than 200°C; ii) all other fuels and iii) realistically usable share based on the temperature level. The estimates made are relatively conservative and the analyses are conducted for industrial facilities in Albania with the highest heat consumption presented under Part I of this report.

At the current level, such an analysis points to the available annual waste heat to total 90-100 MWh/year at the installed thermal capacity of the extraction installation of approximately 20 MW (economisers and other exchangers, use of waste steam, etc.).

However, due to location characteristics and temperature levels, only a small portion of those capacities can actually be utilised in new district heating systems. Therefore, of the industrial installations observed, only those at a distance of less than 5 km from a potential connection to the existing (or possibly planned) DHS have been taken into account.

In order to facilitate waste management, the waste in Albania is classified according to place of origin as municipal and industrial waste and, according to its properties, as hazardous, non-hazardous or inert waste. Municipal waste refers to waste generated in the household and waste similar in nature and composition to household waste, except for production waste, and waste from agriculture and forestry. The first step in the entire system of solid municipal waste management is to ensure the implementation of waste prevention measures defined in the *Waste management plan* of the Albanian Government (2021). The most important measures include the establishment of waste management centres (WMCs) and re-use centres, as well as the provision of equipment required for home composting. The next step consists in establishing a system for the separate collection of municipal waste by ensuring the required infrastructure for municipal waste separation: at the place of its generation, at civic amenity sites, on public surfaces and through the implementation of regulations on special waste categories (SWC).

The poultry farming sector, the most consolidated in Albanian agriculture, the only one that met the need for chickens and eggs. According to Instat, in 2024, there were about 7.56 million chickens throughout the country, the vast majority of them in 63 organized and specialized poultry farms. Figure III-1 presents number of chickens in Albania for the whole period 2004-2024 based on INSTAT figures. Consultant have calculated the manure production based on the specific production of manure production by one chicken. One hen will produce 130 pounds of manure in 1 year, or 1000 hens will produce 65 tons. On the dry basis as sold (approximately 30% water), this amounts to about 51 pounds per hen or 25 tons for 1000 hens per year. Figure III-2 presents wet manure produced in Albania for the whole period 2004-2024 based on the calculation carried out by the consultant. Figure III-3 presents wet manure produced and sold directly to nearby villages as fertiliser in Albania for the whole period 2004-2024 based on the interviews with main chicken farms. Meanwhile, Figure III-4 presents wet manure produced and the amount sold directly in Albania for the whole period 2004-2024 and the analysis shows clearly that amount used directly as fertiliser is approximately 12-20% of total manure produced.

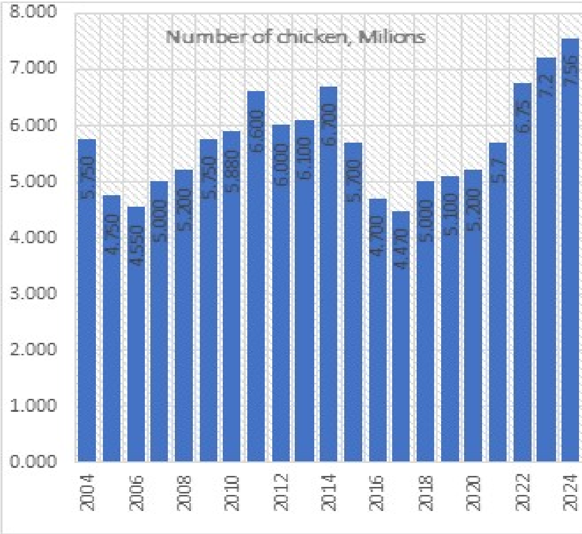


Figure III-1: Number of chickens in Albania for the whole period 2004-2024 (Millions)
Source: Consultant’s calculation

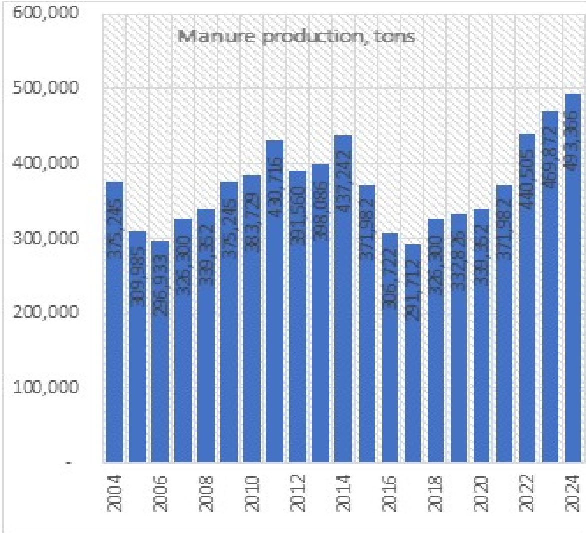


Figure III-2: Chicken’s manure generated in Albania for the whole period 2004-2024 (tons)
Source: Consultant’s calculation

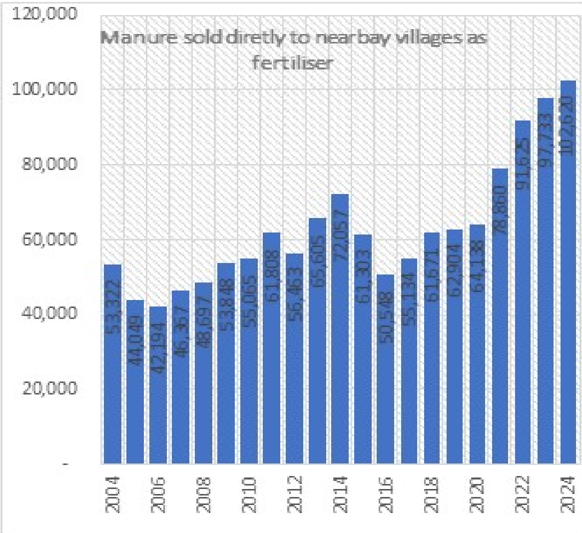


Figure III-3: Wet manure produced and sold directly to nearby villages as fertilizer in Albania for the whole period 2004-2024 (tons)
Source: Consultant’s calculation

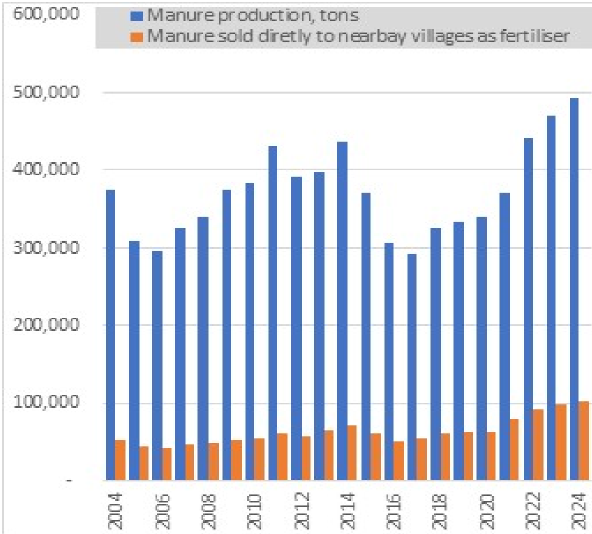


Figure III-4: Wet manure produced and the amount sold directly in Albania for the whole period 2004-2024 (tons)
Source: Consultant’s calculation

Average figures for meat production are considering 1.15 kg/chicken, since the they are sold in the market from 0.75-1.65 kg/chicken. In Albania, there are about 63 chicken poultry farms, but there are no supporting policies and businesses that produce food in the country for poultry and livestock farms (please read below only AIBA is producing large share for their own needs). Poultry and livestock breeding in stables relies entirely on imported foods. Like other agricultural inputs, animal feed in global markets after the war in Ukraine has increased by 100%. High transportation costs after the pandemic increased significantly, directly affecting commodity prices. Market operators claim that the price of 1 ton of chicken feed was 50% higher in the second half of 2021 than in 2020, but after the war in Ukraine the price for the same amount has increased by 50%. Ukraine is the largest global exporter of soybeans and corn, the basis of feed for chickens and livestock. Figure III-5 presents shares of main poultry farms related to the number of chickens in Albania for the year 2024.

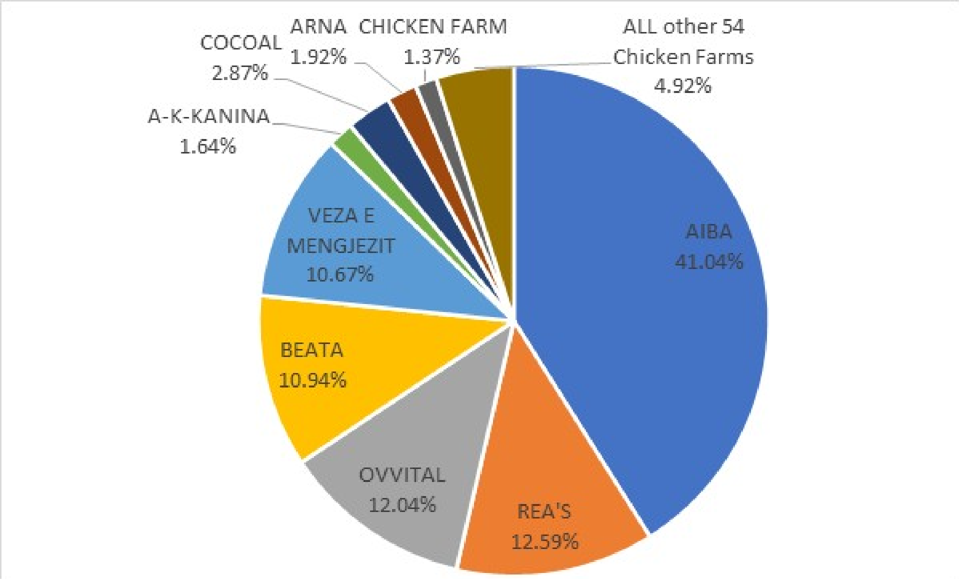


Figure III-5: Share of the main poultry farms related to the number of chickens in Albania for year 2024 (%)
Source: Consultant's calculation

Analysis shows that AIBA, REA'S, OVVITAL, BEATA, VEZA E MENGJESIT are five largest farms with approximately 85-88% of total market in Albania. All remaining manure from chicken (presented in detail above as the most concentrated stables in Albania) and other biomass from livestock and agriculture remains especially from greenhouses to deliver to biological biogas facility will be great energy source especially to be supplied to small to medium district heating plants close to 5 km to chicken farm stables.

Separately collected bio-waste (especially olive oil pomace and all organic remains from the food industry) will be used for production of olive and remaining fruits pomace-pellets, briquets to be used for decentralised systems.

Utilisation of solar hot water systems measure connects solar energy potential with the locations of the existing district heating systems by 2050. It is expected that more than 200,000-250,000 m2 of thermal collectors will be installed in the heating sector by 2050, with the total investment estimated approximately 105-110 million Euro.

A greater integration of RES into district heating systems is estimated to result in a competitive price of heat in the market, which will in turn generate the need to construct new and expand existing distribution infrastructure. The harnessing of solar energy reduces the consumption of fossil fuels, which has a positive impact on the environment.

Utilisation of natural geothermal resources is estimated that the installed capacity in district heating systems will reach 10 MWt by 2050. A greater integration of RES into district heating systems is believed to result in the supply of heat at a highly competitive prices in the market, which will in turn generate the need to build new and expand existing distribution infrastructure. Apart from geothermal heat plants are also noteworthy, especially those of the base load type operating throughout the year with few short interruptions, especially close to curative centres. Such systems increase the efficiency of geothermal installations, and thus the cost-effectiveness of the entire geothermal project. Geothermal energy use reduces the consumption of fossil fuels, which has a positive impact on the environment.

III.4 Defining Technical Criteria Necessary for CHP Schemes

Most renewable energy sources with low to moderate temperatures, such as solar, biomass, and industrial waste heat, geothermal, are difficult to convert efficiently into electricity using conventional power generation. Therefore, this encourages research on several thermodynamic cycles, such as the Rankine cycle, which was widely developed. The Rankine cycle, which involves isentropic compression in the pump, addition of pressure heat in the boiler, isentropic expansion in the expander, and release of pressure heat in the condenser, is suitable and can be used in steam power plants. After condensing steam, the working fluid is fed back into the evaporator to maintain a continuous cycle. Meanwhile, due to the Steam Rankine Cycle (SRC) limitations, the Organic Rankine Cycle (ORC) system has been developed as a solution to the use of low heat sources. Also, it has a more flexible design in several possible system configurations. It has also been stated that heat from a source can be utilized at low temperatures by combining the ORC with the SRC concept and an organic working fluid with a low boiling point.

The ORC system is a potential method for producing electrical power from low-temperature heat sources in renewable energy applications and improving industrial energy efficiency. It is also commonly utilized due to the ease of design and operation. However, the system has several disadvantages currently being investigated by researchers to improve its operations. In recent years, some of the factors designed to ensure improved performance have been categorized into three: the effect of cycle configuration, the choice of operating fluid, and the system's operational working conditions.

Because of its simplicity and reliability, combined heat and power production (CHP) utilizing the ORC system is the most suitable and promising alternative. The system can also be freely applied to several different resources, either as a stand-alone or a Combined Heat and Power Production (CHP). Several factors influence the ORC system's efficiency, including the choice of working fluids, the usage of expanders, the system's adaptability, and working circumstances. Water is commonly utilized as the working fluid in SRCs that operate on a large scale with high-temperature energy sources. However, the thermodynamic nature of the steam produced requires a complicated generator scheme. At the same time, the creation of a liquid fluid during the expansion process also leads to several problems in the turbine. Therefore, water is an unsuitable working fluid for low-temperature energy sources.

Using organic working fluids with boiling points lower than water is promising to generate electrical energy in the ORC. Moreover, the suitability of several components with the configuration of this system also provides an important role in producing optimal work from the ORC system. The selection of a safe and environmentally friendly working fluid with reliable thermodynamic characteristics and suitability at a specific temperature range is necessary to obtain an optimal work cycle and system configuration. Moreover, the temperature range for ORC operation also influences the selection process due to the fluid's thermodynamic properties on cycle efficiency at different applied temperatures.

The critical temperature, critical pressure, and type of expansion of the fluid (dry or wet) are the most typical thermo-physical parameters used to determine the nature of the working fluid. A high-molecular-complexity expander is utilized to lower the average temperature difference between fluids with the same critical temperature, while a heat exchanger is used to prevent exergy losses. Meanwhile, a higher critical temperature also requires an expander with a low rotation speed to obtain a rate close to the optimal value. At low temperatures, the ORC characteristics produce highly efficient power. It requires a simple system configuration, and efficient expanders are very suited for most renewable energy sources, such as solar, biomass, and geothermal, or to increase industrial energy efficiency. Figure III-6 shows the application range of ORC systems based on temperature and power output which is recommended to ensure better conditions for work and efficiency.

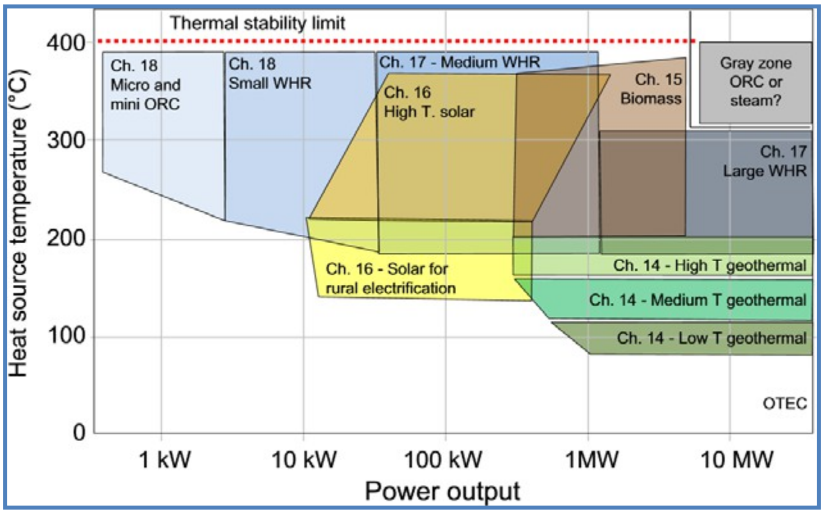


Figure III-6: An overview of ORC uses in the temperature-power output plane of heat sources
Source: www.engineeringscience.uns.ac.id **** ISSN 1451-4117 * Vol.20, No 3, 2022***

The heat source providing the energy required by the ORC system also has different characteristics which significantly influence theoretical analysis and system design. The ORC system overview concerning its technical utilization aspects, transformation, or energy exploitation process is presented in Figure III-7 by following a possible configuration.

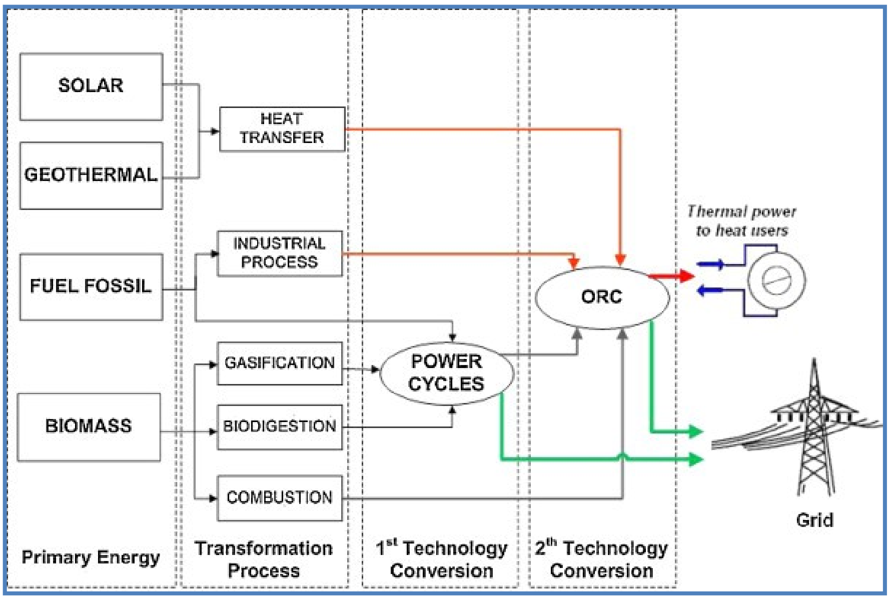


Figure III-7: An overview of ORC's potential applications by energy source
Source: www.engineeringscience.uns.ac.id **** ISSN 1451-4117 * Vol.20, No 3, 2022***

Solar energy-based technology has recently attracted interest in fulfilling the different energy needs of humankind. Concentrated Solar Power (CSP) (figure III-8) is a technique that employs a mirror or lens to focus sunlight on heating fluid and producing steam, which is then utilized to drive turbines and generate power in the same way as conventional power plants work.

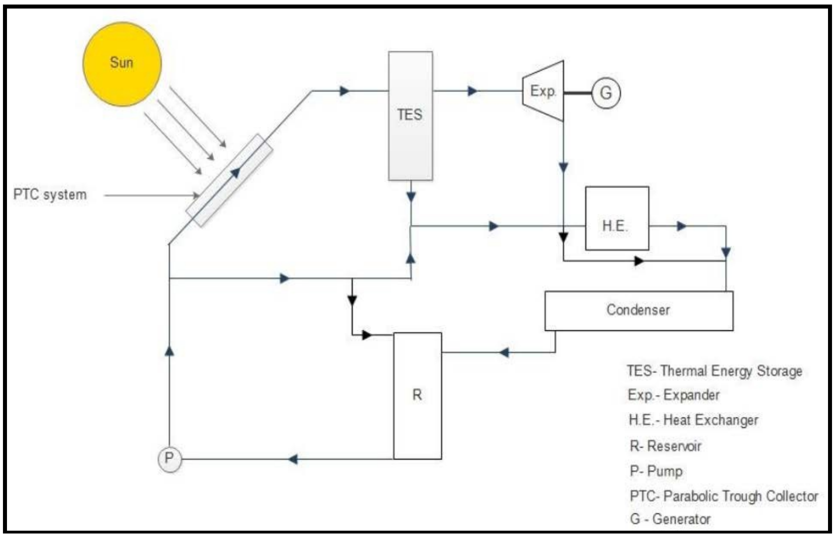


Figure III-8: ORC System Schematic Diagram with Solar Thermal Energy
Source: Consultant's team

Figure III-8 shows a block diagram of the SORC prototype, with the evaporator being a solar parabolic collector system that directly vaporizes the working fluid. To improve the present heating system, the hot steam is held in Thermal Energy Storage (TES). Furthermore, high pressure and temperature steam are directed towards the expander to generate electricity, and the low-pressure steam is cooled in the condenser after departing the expanders.
The heat energy from the sun is used in the Solar Rankine Cycle to heat the working fluid directly using direct vapor generation (DVG) and indirectly utilizing the heat transfer fluid (HTF) through a collector that works as an evaporator. This application shows the configuration of solar energy with an ORCe using a solar thermal collector is very attractive for large capacity plants. Concentrated solar collectors are commonly used for large- power capacity systems because of their high efficiency in the medium to the high-temperature range. Meanwhile, the type of collector used may impact the energy produced's efficiency.
Biomass is one of the most important energy sources, accounting for about 10% of the World and primary energy consumption in Albania and almost is based on the fuel wood. Meanwhile, agriculture biomass is almost not used at all and it burned in the open space, creating fires, causing damages to the environment and this technic shall be stopped immediately. It comes from various industrial and agricultural operations, such as manufacturing and agricultural and forest wastes. Sawdust, wheat and corn straw, and other biomass wastes especially generated from greenhouses and from trees pruning are used as an alternative to fossil fuels. The thermo-chemical and bio-chemical or biological technologies are the two basic procedures for converting these resources to energy. Biomass offers a lot of potential for simultaneously producing combined heat and power (CHP). It can also be used to create power in both external and internal combustion systems. The biomass is burned in a boiler for external combustion. The heat is directed into the ORC, but it must first be transformed into gas through pyrolysis or liquid biofuel in a conventional internal combustion engine. External combustion has the main disadvantage of lower conversion efficiency, whereas internal combustion has the problem of gas purification.

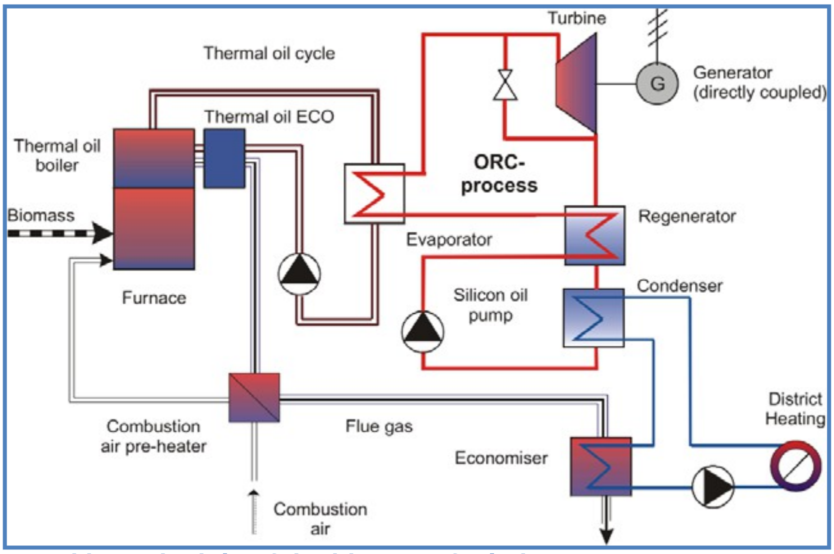


Figure III-9: The working principle of the biomass-fueled ORC process

Source: ***www.engineeringscience.uns.ac.id * ISSN 1451-4117 * Vol.20, No 3, 2022***

Figure III-9 represents the biomass configuration with the ORC system, and the process includes using a hot oil cycle to connect the ORC system to a thermal oil boiler. This ORC system also operates in a closed cycle using silicon oil as the organic pressurized fluid, evaporated, heated by thermal oil in the evaporator, and transmitted in an axial turbine directly connected to an asynchronous generator. Furthermore, before entering the condenser, the silicone oil passes through a regenerator, and the condensation happens at a temperature that allows heat to be collected and utilized as district heat. Later in the cycle, the working fluid passes through the pump to return to the suitable pressure level. Using medium heating media or thermal oil, on the other hand, has various advantages, including low evaporator pressure, insensitivity to load fluctuations, simple, and safe operation.

There are two types of geothermal energy sources. The first is hydrothermal reservoirs containing hot water or steam, immediately injected into the ORC system. The second is Enhanced Geothermal Systems (EGS), which employ cold water pumped into wells drilled through shale to create hot water or steam at temperatures below 650°C. Construction of new geothermal power plants in new fields and enhancing the thermal efficiency of existing power plants are two approaches to developing geothermal power plants. It is possible to apply the ORC technology for geothermal resources to a binary power plant system. The binary power plant system, on the other hand, is currently much more similar to the ORC. By employing waste brine from a separator, this binary geothermal power plant system can be applied to a flash system geothermal power plant. The combination of this system can combine the two system advantages, which allows it to create an ideal cycle. This combined flash-binary geothermal power plant uses at least two turbines, making it possible to produce more power even with the same power source. The configuration of the two systems is shown in Figure III-10.

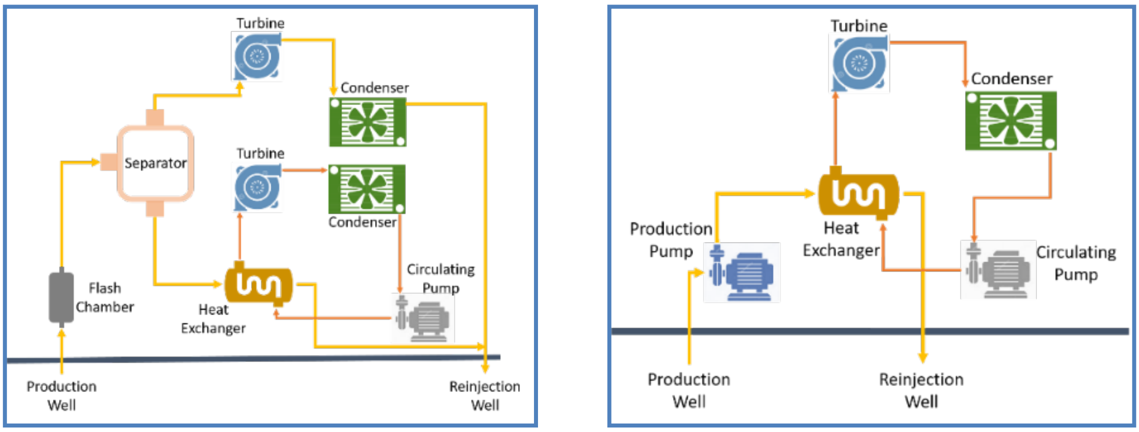


Figure III-10: (a) Combined Flash-Binary Power Plant and (b) Binary Geothermal Power Plant

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However, while implementing ORC technology in a binary geothermal power plant, various factors must be considered, including the working fluid, condensation temperature and pressure, cooling media, expander technology, and cycle type. Meanwhile, the integrated system performance of the supercritical ORC cycle- based hybrid system is the best one.

The development of waste heat and the lack of appropriate equipment for cost-effective usage of low-level heat are the fundamental energy inefficiencies in an industrial system. The Waste Heat Recovery System (WHRS) is a cost-effective, ecologically acceptable technology for saving energy in an industry by repurposing waste heat even at low temperatures. It is also proven to increase energy effectiveness and provide considerable economic benefits such as reducing fuel consumption and even CO2 production in an integrated energy generating unit with WHRS. It is due to the prospect of providing a profitable energy source while also lowering overall energy usage through numerous WHRS technologies to recover waste heat.

However, it is important to note that each waste heat temperature range has a specific WHRS technology to obtain the most optimal efficiency. It is also possible to use heat sources directly for energy generation needs in direct usage and heat exchangers. Furthermore, the thermodynamic cycle can be used directly to recover heat from waste to generate electrical energy or improve a process's energy efficiency. Through a comparative thermodynamic analysis of ORC also stated that using thermodynamic cycles with organic working fluids offers cost-effectiveness and energy recovery approaches that are more promising for intermediate-level waste heat sources. Furthermore, the ORC system is a thermodynamic cycle and WHRS technology that may use waste heat in power plants employing a variety of energy sources, including biomass, solar and geothermal, at low temperatures (less than 100°C). The system's main advantage is converting energy that would otherwise be wasted into reusable energy. Therefore, it significantly reduces thermal pollution and fossil fuel consumption (figure III-11).

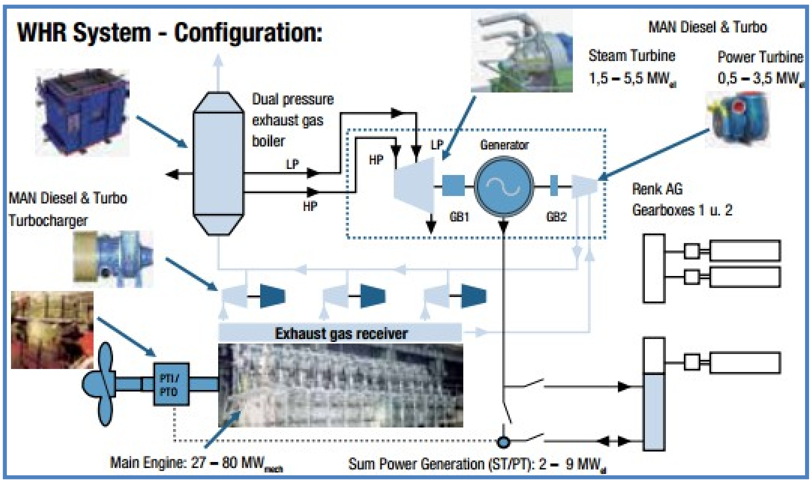

Figure III-11: WHR Working Principles

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Figure III-11 is an example of the application of the WHRS principle to a MAN B&W low-speed diesel engine with the exhaust gas observed to be flowing pass the main turbocharger engine through the exhaust gas bypass. Therefore, this reduces the total incoming air and exhaust gas and subsequently increases the exhaust gas temperature. This further causes an increment in steam production in the boiler, which is later used in turbines to produce electrical energy. As part of the WHRS, a pressure decrease at the exhaust gas bypass can also be exploited to generate power using a secondary turbine.

The use of the ORC system needs to consider various aspects other than its work performance. Some of the elements that need to be considered in using this ORC system include environmental and economic issues. In this case, the impact of the ORC working fluid on the environment is very important. Some things that need to be considered are fluids with high Ozone Depletion Potential (ODP). In addition, organic fluorinated liquids (HFCs) should be avoided as they have a high Global Warming Potential (GWP). GWP is not only necessary for environmental concerns but also cycle efficiency. It can be seen that the working fluid with a GWP lower than 1500 can absorb more energy from the heat source to increase the cycle efficiency.

Compared to water or steam cycles, ORC systems provide limited performance due to low to moderate operating temperature levels. However, the ORC system can convert low-grade heat input into energy at an acceptable conversion ratio. In this case, the configuration of the ORC system can also play an important role in the resulting environmental impact. As with the use of a recuperator which can reduce the average heat transfer temperature to the environment, it is lower and results in higher cycle thermal efficiency and reduces the resulting thermal pollution to the environment.

Organic fluids are expensive, so it is important to find a suitable trade-off between cost and performance. In general, the fluids used in the operation of the ORC system are fluids that have been widely used in other fields. It aims to obtain organic fluids at lower prices. Expanders have an important role in generating system performance. In this regard, investigations using volumetric expanders have been carried out to provide good performance at lower costs. Cost reductions for high-speed power generators with a working fluid that does not require excessively high turbine rotational speeds can increase the cost-effective capabilities of small-scale ORC units.

Under favourable evaporating pressure and condensing temperature conditions for a wide range of ORC applications, the specific cost per kilowatt-hour decreases as thermal efficiency increases. In addition, lower condensing temperatures or higher evaporating pressures can also lower the specific cost per kilowatt-hour. On the other hand, with a constant condensing temperature and vaporization pressure, a working fluid with a higher critical temperature can achieve a lower specific cost.

The ORC system is a promising technology for generating energy by utilizing heat sources at low temperatures. However, the cycle configuration, working fluid selection, and operational working conditions in the system all impact its performance. Because of its simplicity and reliability when linked with other production systems, Combined Heat and Power Production (CHP) based on a small-scale ORC system were one of the best and most promising alternatives. Meanwhile, while choosing an expander for the system, numerous criteria must be addressed, including power capacity, isentropic efficiency, cost, and complexity. However, Scroll-expanders were preferred because of their excellent efficiency, low noise and vibration levels, and great reliability. With the inclusion of OFOH and IHE in the RORC configuration, the configuration was also an important factor affecting system performance, with IHE enhancing performance and reducing the cycle’s energy loss. Furthermore, the ORC system’s properties make it ideal for most renewable energy sources, including solar, and biomass, geothermal, and it offers the industry increased energy efficiency by utilizing waste heat. The findings revealed that integrating the ORC system with various energy sources provides proper operation, improved efficiency, and multiple benefits such as increased power and reduced pollution by limiting wasted heat.

At the present times the best CHP units are Organic Rankine Cycle types (ORC). The ORC process is based on utilization of organic substance mediums, which have favourable thermodynamic properties at lower temperatures and pressures. These include hydrocarbons such as iso-pentane, iso-octane, toluene, and silicon oil. The heat produced in the furnace enters the ORC process, through the flue gases which transmit the heat to the thermal oil exchanger. This technology has many technical advantages, such as; high cycle efficiency, very high turbine efficiency (up to 90%), low mechanical stress etc. In addition, it has many operational advantages such as; simple start-stop procedures, automatic and continuous operation, quiet operation, etc. The two main equipment of a CHP plant with ORC technology are the Thermal Oil Boiler, and the Modular CHP plant. The Modular CHP plant includes ORC turbo generator, condenser, regenerator, and evaporator. Below there is the conceptual configuration of a CHP boiler-filter-generator unit.

III.5 Proposed Measures for Decentralised (Individual) Systems

This session includes proposes measures relating to individual systems at the level of buildings. The measures are presented separately for the household sector and the service sector, along with the achieved in delivered energy and CO_2 emissions savings as a result of their implementation. Moreover, the measures are also presented according to purpose: heating, DHW preparation and cooling, with the course of their implementation provided for two target years: 2030, 2040 and 2050. It is important to note that the measures below refer solely to heating, DHW preparation and cooling technologies, and that their drafting was based on data from the baseline scenario (presented under Part I), aimed at achieving the energy consumption provided in the scenario with implemented measures referred to in the Integrated National Energy and Climate Plan for Albania (NECP).

III.5.1 Modern Biomass Potential

Biomass is a widely used energy resource in Albania – predominantly in the form of firewood including shrubs and agricultural residual plants. The consumption of firewood had been significantly decreased in the last two and a half decades due to wider use of other sources, but in the last recent years the fuel wood consumption has increased slightly due to increased prices of other fuels and electricity. The available biomass waste from agriculture is only partly and theoretically assessed and in many extends is usually destroyed on the spot. The use of biogas is in its initial stage of development beside its large potentials. Processed wood fuels as pellets and briquettes are in the initial face with some unite established in Elbasan, Korca, Prograde, etc.

The sectoral assessment of the biomass potential with a focus on the olive oil sector includes: Availability and current use of bio-wastes along with biomass potential ; Existing barriers/risks/opportunities for the olive-oil market and other key sectors; future barriers/risks/opportunities for the olive-oil market and other key sectors, and market growth assumptions; Geographic distribution of olive-oil and other key sector's production facilities along with their bio-waste potentials (amount and availability) to provide a basis for examination the centralized energy usage possibility.

Olive orchards constitute an important sector in the development of agriculture in Albania. Nutritional and curative values of olive oil are known, and in this way the olive cultivation is important in meeting the nutritional needs of the population. The country has also a long tradition of olive cultivation which dates for several centuries. Native cultivators of olives are the best witnesses of the compatibility and tradition with the olive cultivation in the country.

Climatic-soil conditions in the western, central and south-western zone of the country favour the cultivation of olives and are exactly these zones where olive cultivation is widespread, and which it also relates to the production of olive oil, olive grains for conservation, the use of olive trees for the wood processing industry as well as for other aspects of the use as olive residues for energy production, the use of olive leaves for the cosmetic industry, etc. All these usages increase the value added of olive and positively affect in the value chain.

Olives in production (> 10 years) doubled for the same period (3.2, 6.33, 18.85 million roots for 1990, 2000 approx. on 2024, respectively). Olive harvesting is variable and varies from 8.6 kg roots (2005) to 25.9 kg / roots/tree (2012) and 32 kg/tree approx. on 2024 depending on climatic conditions; Progressive increase in productivity in recent years is the result of better technologies and added maintenance services such as irrigation and fertilization. Also, the introduction of new production varieties, from an early age, has improved the variance structure and has reduced the phenomenon of periodicity. Table III-3 presents the surface, number and production of olives during 2000-2024 based on the data collected from different sources by EECG consultant team. Table III-3 presents the data on yearly amount of olive pruning for the year 2024 for all prefectures of Albania based on the data collected from different sources by EECG consultant team.

Table III-3: Data on yearly amount of olive pruning production for the year 2024 for all prefectures of Albania

No	Prefectures	Surface (ha)	Total roots/trees (Olives/000)	Olive wet biomass from prunning (Total ton)	Olive dry biomass from prunning (Total ton)	Olive dry biomass from prunning (Total in energy terms, GWh/year)
1	Berat	13,513	3,525	105,753	81,958	304.96
2	Durres	3,422	853	25,579	19,824	73.76
3	Elbasan	7,703	3,040	91,215	70,691	263.03
4	Fier	22,123	4,588	137,650	106,679	396.94
5	Gjirokaster	1,072	591	17,728	13,739	51.12
6	Lezhe	525	431	12,943	10,031	37.32
7	Shkoder	1,126	865	25,947	20,109	74.82
8	Tirane	6,822	1,713	51,404	39,838	148.23
9	Vlore	15,826	3,253	97,594	75,635	281.43
Total, Albania		**72,132**	**18,860**	**565,813**	**438,505**	**1,631.63**

Source: Calculation carried out by the EECG consulting team based on data of INSTAT, Agricultural Technology Transfer Centre, Vlora, Ministry of Agriculture and Rural Development, 2025

Table III-4 figures can be used as a guide for expected yields and costs for a mature and fully irrigated Albanian olive grove sited correctly. For non-irrigated crops, the yield can be expected to be substantially lower, by up to 40-50%.

Table III-4: Average values to be expected yield for mature fully irrigated olive grove according to interviews carried out for 15 different olive farms

Annual yield of fresh olives per tree	**100 kg**
Oil varieties % oil	20-25%
Weight of olive oil per tree	20-25 kg
Weight of one litre of olive oil	0.9 kg
Oil production per tree	10-12.5 litters'
Wet olive pomace per 100 kg	70-75 kg for 100 kg of olive processed

Source: Calculation carried out by the EECG consulting team based on data of INSTAT, Agricultural Technology Transfer Centre, Vlora, Ministry of Agriculture and Rural Development, 2025

Two types of wastes are generated by olive industry: Olive mill technology generates a variety of wastes, both solid and liquid. The solid wastes generated in the olive oil extraction are alperujo [Spanish] (i.e. pomace from the two phase system), and orujo [Spanish] (i.e. pomace from the three phase system). Figure III-12 presents the percentage of olive oil and olive pomace/seeds biomass generated for all different varieties of olives in Albania. The results shows that specific olive oil generated is 20-25 litters and the remaining part of 75-80 kg of olive pomace for 100 kg of olive processed.

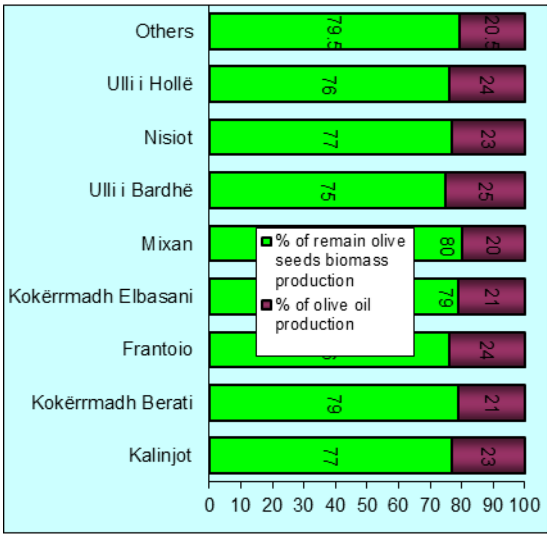


Figure III-12: Percentage of olive oil and olive pomace/seeds biomass generated for all different varieties of olives

Source: Calculation carried out by the EECG consulting team, 2025

Figure III-13: Calculated Olive pomace/seeds biomass generated from all olive oil mills (000 ton)

Source: Calculation carried out by the EECG consulting team, 2025

Table III-5 presents the calculated data on yearly amount of olive pomace generated for the year 2024 for all prefectures of Albania based on the data collected from different sources by EECG consultant team.

Table III-5: Calculated data on yearly amount of olive pomace generated for the year 2024 for all prefectures of Albania

No	Prefectures	Total roots/trees (Olives/000)	Oil Olive (Total ton)	Wet Olive Oil pomace (Total ton)	Dry Olive Oil pomace (Total ton)	Dry Olive Oil pomace (Total in energy terms, GWh/year)
1	Berat	3,525	4,131	16,567	9,940	54.12
2	Durres	853	1,630	6,535	3,921	21.35
3	Elbasan	3,040	4,216	16,908	10,145	55.23
4	Fier	4,588	10,016	40,170	24,102	131.22
5	Gjirokaster	591	575	2,309	1,385	7.54
6	Lezhe	431	493	1,978	1,187	6.46
7	Shkoder	865	292	1,172	703	3.83
8	Tirane	1,713	1,753	7,032	4,219	22.97
9	Vlore	3,253	6,899	27,668	16,601	90.38
Total, Albania		**18,860**	**30,004**	**120,339**	**72,203**	**393.11**

Source: Calculation carried out by the EECG consulting team based on the INSTAT, Agricultural Technology Transfer Centre, Vlora, Ministry of Agriculture and Rural Development, 2025

III.5.2 Residential Building Stock

Energy efficiency measures for the household sector include the replacement of fossil fuels with renewable energy sources, the introduction of more efficient technologies such as very highly efficient stoves with wood/pellets, biomass condensing boilers and heat pumps, as well as the use of solar energy for heating and DHW preparation. The proposed measures are presented in more detail in the table III-6. The required thermal capacity of the source that needs to be installed, as well as the annual savings in delivered energy and CO2 emissions resulting from the implementation of certain measures have been calculated and presented for each measure. Table III-7 presents the installed capacity needed and annual primary energy and CO2 emissions savings after the implementation of measures for DHW preparation. Meanwhile, the table III-8 presents installed capacity needed and annual primary energy and CO2 emissions savings after the implementation of measures for efficient space cooling.

Table III-6: HOUSEHOLD SECTOR – Installed capacity needed, annual primary energy and CO2 emissions savings after the implementation of measures for efficient space heating

No.	Description of the measure	2030	2040	2050
	Installed thermal capacity needed [MW]	**995.34**	**1070.62**	**1395.26**
1	Replacement of traditional biomass stoves with modern highly efficient biomass stoves	159.25	171.30	223.24
2	Replacement of traditional biomass boilers with heat pumps	149.30	160.59	209.29
3	Solar heating combined with heat pumps	89.58	96.36	125.57
4	Replacement of room-based wood-fired centralised space heating with wood-fired district space heating	59.72	64.24	83.72
5	Replacement of fuel oil boilers with modern biomass boilers	39.81	42.82	55.81
6	Replacement of fuel oil boilers with heat pumps	59.72	64.24	83.72
7	Replacement of LPG boilers with modern biomass boilers	109.49	117.77	153.48
8	Replacement of LPG boilers with heat pumps	119.44	128.47	167.43
9	Increase in the share of heat pumps vs. electric resistance heating	179.16	192.71	251.15
10	Natural gas DH/CHP (for new districts areas within cities with MABs & Single villas with high heat density)	29.86	32.12	41.86
	Primary energy savings [GWh]	**939.55**	**1859.22**	**2197.59**
1	Replacement of traditional biomass stoves with modern highly efficient biomass stoves	75.16	148.74	175.81
2	Replacement of traditional biomass boilers with heat pumps	84.56	167.33	197.78
3	Solar heating combined with heat pumps	112.75	223.11	263.71
4	Replacement of room-based wood-fired centralised space heating with wood-fired district space heating	84.56	167.33	197.78
5	Replacement of fuel oil boilers with modern biomass boilers	93.96	185.92	219.76
6	Replacement of fuel oil boilers with heat pumps	75.16	148.74	175.81
7	Replacement of LPG boilers with modern biomass boilers	140.93	278.88	329.64
8	Replacement of LPG boilers with heat pumps	131.54	260.29	307.66
9	Increase in the share of heat pumps vs. electric resistance heating	75.16	148.74	175.81
10	Natural gas DH/CHP (for new districts areas within cities with MABs & Single villas with high heat density)	65.77	130.15	153.83
	GHG reduction [kton]	**87.67**	**210.40**	**280.20**
1	Replacement of traditional biomass stoves with modern highly efficient biomass stoves	7.01	16.83	22.42
2	Replacement of traditional biomass boilers with heat pumps	7.89	18.94	25.22
3	Solar heating combined with heat pumps	10.52	25.25	33.62
4	Replacement of room-based wood-fired centralised space heating with wood-fired district space heating	7.89	18.94	25.22
5	Replacement of fuel oil boilers with modern biomass boilers	8.77	21.04	28.02
6	Replacement of fuel oil boilers with heat pumps	7.01	16.83	22.42
7	Replacement of LPG boilers with modern biomass boilers	13.15	31.56	42.03
8	Replacement of LPG boilers with heat pumps	12.27	29.46	39.23
9	Increase in the share of heat pumps vs. electric resistance heating	7.01	16.83	22.42
10	Natural gas DH/CHP (for new districts areas within cities with MABs & Single villas with high heat density)	6.14	14.73	19.61

Source: Calculation carried out by the EECG consulting team

Table III-7: HOUSEHOLD SECTOR – Installed capacity needed and annual primary energy and CO2 emissions savings after the implementation of measures for DHW preparation

No.	Description of the measure	2030	2040	2050
	Installed thermal capacity needed [MW]	**254.18**	**289.93**	**425.14**
1	Replacement of electric boilers with solar collectors	203.35	231.95	340.11
2	Replacement of traditional biomass boilers with heat pumps	22.88	26.09	38.26
3	Solar heating combined with heat pumps	5.08	5.80	8.50
4	Installation of solar collectors for DHW preparation (where diesel is currently used as energy product)	1.27	1.45	2.13
5	Installation of solar collectors for DHW preparation (where LPG is currently used as energy product)	6.61	7.54	11.05
6	Natural gas DH/CHP (for new districts areas within cities with MABs & Single villas with high heat density)	15.00	17.11	25.08
	Primary energy savings [GWh]	**244.28**	**483.40**	**571.37**
1	Replacement of electric boilers with solar collectors	195.43	386.72	457.10
2	Replacement of traditional biomass boilers with heat pumps	21.99	43.51	51.42
3	Solar heating combined with heat pumps	4.89	9.67	11.43
4	Installation of solar collectors for DHW preparation (where diesel is currently used as energy product)	1.22	2.42	2.86
5	Installation of solar collectors for DHW preparation (where LPG is currently used as energy product)	6.35	12.57	14.86
6	Natural gas DH/CHP (for new districts areas within cities with MABs & Single villas with high heat density)	14.66	29.00	34.28
	GHG reduction [kton]	**22.79**	**54.70**	**72.85**
1	Replacement of electric boilers with solar collectors	18.24	43.76	58.28
2	Replacement of traditional biomass boilers with heat pumps	2.05	4.92	6.56
3	Solar heating combined with heat pumps	0.46	1.09	1.46
4	Installation of solar collectors for DHW preparation (where diesel is currently used as energy product)	0.11	0.27	0.36
5	Installation of solar collectors for DHW preparation (where LPG is currently used as energy product)	0.59	1.42	1.89
6	Natural gas DH/CHP (for new districts areas within cities with MABs & Single villas with high heat density)	1.37	3.28	4.37

Source: Calculation carried out by the EECG consulting team

Table III-8: HOUSEHOLD SECTOR – Installed capacity needed and annual primary energy and CO2 emissions savings after the implementation of measures for efficient space cooling

No.	Description of the measure	2030	2040	2050
	Installed thermal capacity needed [MW]	**254.18**	**289.93**	**425.14**
1	Replacement of old split AC units with higher EE AC units	244.53	308.83	530.19
2	Replacement of old split AC units with central higher EE AC unit	61.13	77.21	132.55
	Primary energy savings [GWh]	**112.75**	**223.11**	**263.71**
1	Replacement of old split AC units with higher EE AC units	90.20	178.49	210.97
2	Replacement of old split AC units with central higher EE AC unit	22.55	44.62	52.74
	GHG reduction [kton]	**10.52**	**25.25**	**33.62**
1	Replacement of old split AC units with higher EE AC units	8.42	20.20	26.90
2	Replacement of old split AC units with central higher EE AC unit	2.10	5.05	6.72

Source: Calculation carried out by the EECG consulting team

The implementation of the described measures will result in a significant reduction of fossil fuel consumption and, consequently, in greenhouse gas emissions too. Whenever technically feasible, fossil fuel stoves and boilers are to be replaced with renewable energy sources and more efficient technologies such as heat pumps.

III.5.2 Public Service Building Stock

Energy efficiency measures for the central and municipal public sector include the replacement of fossil fuels with renewable energy sources, the introduction of more efficient technologies such as very highly efficient stoves with wood/pellets, biomass condensing boilers and heat pumps, as well as the use of solar energy for heating and DHW preparation. The proposed measures are presented in more detail in the tables III-9 including the needs capacities to be installed, as well as the annual savings in delivered energy and CO2 emissions resulting from the implementation of all EE/RES measures have been calculated.

Table III-9: Public Service Building Stock – Installed capacity needed, annual primary energy and CO2 emissions savings after the implementation of EE/RES measures for efficient space heating

No.	Description of the measure	2030	2040	2050
	Installed thermal capacity needed [MW]	**91.22**	**92.20**	**133.41**
1	Replacement of traditional biomass stoves with modern highly efficient biomass stoves	17.33	17.52	25.35
2	Replacement of traditional biomass boilers with heat pumps	15.51	15.67	22.68
3	Solar heating combined with heat pumps	9.12	9.22	13.34
4	Replacement of room-based wood-fired centralised space heating with wood-fired district space heating	4.56	4.61	6.67
5	Replacement of fuel oil boilers with modern biomass boilers	5.47	5.53	8.00
6	Replacement of fuel oil boilers with heat pumps	6.39	6.45	9.34
7	Replacement of LPG boilers with modern biomass boilers	4.56	4.61	6.67
8	Replacement of LPG boilers with heat pumps	3.65	3.69	5.34
9	Increase in the share of heat pumps vs. electric resistance heating	10.03	10.14	14.67
10	Natural gas DH/CHP (for primary hospitals, regional hospitals, large central and municipal public buildings with high heat density)	14.59	14.75	21.35
	Primary energy savings [GWh]	**53.38**	**99.27**	**130.28**
1	Replacement of traditional biomass stoves with modern highly efficient biomass stoves	10.14	18.86	24.75
2	Replacement of traditional biomass boilers with heat pumps	9.08	16.88	22.15
3	Solar heating combined with heat pumps	5.34	9.93	13.03
4	Replacement of room-based wood-fired centralised space heating with wood-fired district space heating	2.67	4.96	6.51
5	Replacement of fuel oil boilers with modern biomass boilers	3.20	5.96	7.82
6	Replacement of fuel oil boilers with heat pumps	3.74	6.95	9.12
7	Replacement of LPG boilers with modern biomass boilers	2.67	4.96	6.51
8	Replacement of LPG boilers with heat pumps	2.14	3.97	5.21
9	Increase in the share of heat pumps vs. electric resistance heating	5.87	10.92	14.33
10	Natural gas DH/CHP (for primary hospitals, regional hospitals, large central and municipal public buildings with high heat density)	8.54	15.88	20.84
	GHG reduction [kton]	**4.98**	**11.23**	**16.61**
1	Replacement of traditional biomass stoves with modern highly efficient biomass stoves	0.95	2.13	3.16
2	Replacement of traditional biomass boilers with heat pumps	0.85	1.91	2.82
3	Solar heating combined with heat pumps	0.50	1.12	1.66
4	Replacement of room-based wood-fired centralised space heating with wood-fired district space heating	0.25	0.56	0.83
5	Replacement of fuel oil boilers with modern biomass boilers	0.30	0.67	1.00
6	Replacement of fuel oil boilers with heat pumps	0.35	0.79	1.16
7	Replacement of LPG boilers with modern biomass boilers	0.25	0.56	0.83
8	Replacement of LPG boilers with heat pumps	0.20	0.45	0.66
9	Increase in the share of heat pumps vs. electric resistance heating	0.55	1.24	1.83
10	Natural gas DH/CHP (for primary hospitals, regional hospitals, large central and municipal public buildings with high heat density)	0.80	1.80	2.66

Source: Calculation carried out by the EECG consulting team

Table III-10: Public Service Building Stock – Installed capacity needed, annual primary energy and CO2 emissions savings after the implementation of EE/RES measures for efficient DHW preparation

No.	Description of the measure	2030	2040	2050
	Installed thermal capacity needed [MW]	**16.43**	**17.56**	**29.92**
1	Replacement of electric boilers with solar collectors	13.15	14.05	23.94

2	Replacement of traditional biomass boilers with heat pumps	1.48	1.58	2.69
3	Solar heating combined with heat pumps	0.33	0.35	0.60
4	Installation of solar collectors for DHW preparation (where diesel is currently used as energy product)	0.08	0.09	0.15
5	Installation of solar collectors for DHW preparation (where LPG is currently used as energy product)	0.43	0.46	0.78
6	Natural gas DH/CHP (for primary hospitals, regional hospitals, large central and municipal public buildings with high heat density)	0.97	1.04	1.77
	Primary energy savings [GWh]	**9.62**	**18.91**	**29.22**
1	Replacement of electric boilers with solar collectors	7.70	15.13	23.38
2	Replacement of traditional biomass boilers with heat pumps	0.87	1.70	2.63
3	Solar heating combined with heat pumps	0.19	0.38	0.58
4	Installation of solar collectors for DHW preparation (where diesel is currently used as energy product)	0.05	0.09	0.15
5	Installation of solar collectors for DHW preparation (where LPG is currently used as energy product)	0.25	0.49	0.76
6	Natural gas DH/CHP (for primary hospitals, regional hospitals, large central and municipal public buildings with high heat density)	0.58	1.13	1.75
	GHG reduction [kton]	**0.90**	**2.14**	**3.73**
1	Replacement of electric boilers with solar collectors	0.72	1.71	2.98
2	Replacement of traditional biomass boilers with heat pumps	0.08	0.19	0.34
3	Solar heating combined with heat pumps	0.02	0.04	0.07
4	Installation of solar collectors for DHW preparation (where diesel is currently used as energy product)	0.00	0.01	0.02
5	Installation of solar collectors for DHW preparation (where LPG is currently used as energy product)	0.02	0.06	0.10
6	Natural gas DH/CHP (for primary hospitals, regional hospitals, large central and municipal public buildings with high heat density)	0.05	0.13	0.22

Source: Calculation carried out by the EECG consulting team

Table III-11: Public Service Building Stock – Installed capacity needed, annual primary energy and CO2 emissions savings after the implementation of EE/RES measures for efficient space cooling

No.	Description of the measure	2030	2040	2050
	Installed thermal capacity needed [MW]	**16.82**	**21.20**	**45.75**
1	Replacement of old split AC units with higher EE AC units for small municipal public buildings	13.46	16.96	36.60
2	Replacement of old split AC units with central higher EE AC unit for large municipal public buildings	3.36	4.24	9.15
	Primary energy savings [GWh]	**9.84**	**22.83**	**44.68**
1	Replacement of old split AC units with higher EE AC units for small municipal public buildings	7.88	18.26	35.74
2	Replacement of old split AC units with central higher EE AC unit for large municipal public buildings	1.97	4.57	8.94
	GHG reduction [kton]	**0.87**	**2.08**	**3.61**
1	Replacement of old split AC units with higher EE AC units for small municipal public buildings	0.70	1.66	2.89
2	Replacement of old split AC units with central higher EE AC unit for large municipal public buildings	0.17	0.42	0.72

Source: Calculation carried out by the EECG consulting team

III.5.3 Private Service and Commercial Building Stock

Energy efficiency measures for the Private Service and Commercial Building Stock include the replacement of fossil fuels with renewable energy sources, the introduction of more efficient technologies such as very highly efficient stoves with wood/pellets, biomass condensing boilers and heat pumps, as well as the use of solar energy for heating and DHW preparation. The proposed measures are presented in more detail in the tables III-12 including the needs capacities to be installed, as well as the annual savings in delivered energy and CO2 emissions resulting from the implementation of all EE/RES measures have been calculated.

Table III-12: Private Service and Commercial Building Stock – Installed capacity needed, annual primary energy and CO2 emissions savings after the implementation of EE/RES measures for efficient space heating

No.	Description of the measure	2030	2040	2050
	Installed thermal capacity needed [MW]	**301.14**	**360.36**	**411.16**
1	Replacement of traditional biomass stoves with modern highly efficient biomass stoves	57.22	68.47	78.12
2	Replacement of traditional biomass boilers with heat pumps	51.19	61.26	69.90
3	Solar heating combined with heat pumps	30.11	36.04	41.12
4	Replacement of room-based wood-fired centralised space heating with wood-fired district space heating	15.06	18.02	20.56
5	Replacement of fuel oil boilers with modern biomass boilers	18.07	21.62	24.67
6	Replacement of fuel oil boilers with heat pumps	21.08	25.23	28.78
7	Replacement of LPG boilers with modern biomass boilers	15.06	18.02	20.56
8	Replacement of LPG boilers with heat pumps	12.05	14.41	16.45
9	Increase in the share of heat pumps vs. electric resistance heating	33.13	39.64	45.23
10	Natural gas DH/CHP (for supermarket, hotel, large private hospitals, large private schools, private service and other commercial buildings)	48.18	57.66	65.79
	Primary energy savings [GWh]	**176.24**	**388.00**	**401.51**
1	Replacement of traditional biomass stoves with modern highly efficient biomass stoves	33.49	73.72	76.29
2	Replacement of traditional biomass boilers with heat pumps	29.96	65.96	68.26
3	Solar heating combined with heat pumps	17.62	38.80	40.15
4	Replacement of room-based wood-fired centralised space heating with wood-fired district space heating	8.81	19.40	20.08
5	Replacement of fuel oil boilers with modern biomass boilers	10.57	23.28	24.09
6	Replacement of fuel oil boilers with heat pumps	12.34	27.16	28.11
7	Replacement of LPG boilers with modern biomass boilers	8.81	19.40	20.08
8	Replacement of LPG boilers with heat pumps	7.05	15.52	16.06
9	Increase in the share of heat pumps vs. electric resistance heating	19.39	42.68	44.17
10	Natural gas DH/CHP (for supermarket, hotel, large private hospitals, large private schools, private service and other commercial buildings)	28.20	62.08	64.24
	GHG reduction [kton]	**16.45**	**43.91**	**51.19**
1	Replacement of traditional biomass stoves with modern highly efficient biomass stoves	3.12	8.34	9.73
2	Replacement of traditional biomass boilers with heat pumps	2.80	7.46	8.70
3	Solar heating combined with heat pumps	1.64	4.39	5.12
4	Replacement of room-based wood-fired centralised space heating with wood-fired district space heating	0.82	2.20	2.56
5	Replacement of fuel oil boilers with modern biomass boilers	0.99	2.63	3.07
6	Replacement of fuel oil boilers with heat pumps	1.15	3.07	3.58
7	Replacement of LPG boilers with modern biomass boilers	0.82	2.20	2.56
8	Replacement of LPG boilers with heat pumps	0.66	1.76	2.05
9	Increase in the share of heat pumps vs. electric resistance heating	1.81	4.83	5.63
10	Natural gas DH/CHP (for supermarket, hotel, large private hospitals, large private schools, private service and other commercial buildings)	2.63	7.03	8.19

Source: Calculation carried out by the EECG consulting team

Table III-13: Private Service and Commercial Building Stock – Installed capacity needed, annual primary energy and CO2 emissions savings after the implementation of EE/RES measures for efficient DHW preparation

No.	Description of the measure	2030	2040	2050
	Installed thermal capacity needed [MW]	**110.09**	**113.080151**	**116.15**
1	Replacement of electric boilers with solar collectors	66.05	67.85	69.69
2	Replacement of traditional biomass boilers with heat pumps	11.01	11.31	11.62
3	Solar heating combined with heat pumps	16.51	16.96	17.42
4	Installation of solar collectors for DHW preparation (where diesel is currently used as energy product)	5.50	5.65	5.81
5	Installation of solar collectors for DHW preparation (where LPG is currently used as energy product)	3.30	3.39	3.48
6	Natural gas DH/CHP (for supermarket, hotel, large private hospitals, large private schools, private service and other commercial buildings)	7.71	7.92	8.13
	Primary energy savings [GWh]	**64.43**	**121.75**	**113.43**
1	Replacement of electric boilers with solar collectors	38.66	73.05	68.06

2	Replacement of traditional biomass boilers with heat pumps	6.44	12.18	11.34
3	Solar heating combined with heat pumps	9.66	18.26	17.01
4	Installation of solar collectors for DHW preparation (where diesel is currently used as energy product)	3.22	6.09	5.67
5	Installation of solar collectors for DHW preparation (where LPG is currently used as energy product)	1.93	3.65	3.40
6	Natural gas DH/CHP (for supermarket, hotel, large private hospitals, large private schools, private service and other commercial buildings)	4.51	8.52	7.94
	GHG reduction [kton]	**6.01**	**13.78**	**14.46**
1	Replacement of electric boilers with solar collectors	3.61	8.27	8.68
2	Replacement of traditional biomass boilers with heat pumps	0.60	1.38	1.45
3	Solar heating combined with heat pumps	0.90	2.07	2.17
4	Installation of solar collectors for DHW preparation (where diesel is currently used as energy product)	0.30	0.69	0.72
5	Installation of solar collectors for DHW preparation (where LPG is currently used as energy product)	0.18	0.41	0.43
6	Natural gas DH/CHP (for supermarket, hotel, large private hospitals, large private schools, private service and other commercial buildings)	0.42	0.96	1.01

Source: Calculation carried out by the EECG consulting team

Table III-14: Private Service and Commercial Building Stock – Installed capacity needed, annual primary energy and CO2 emissions savings after the implementation of EE/RES measures for efficient space cooling

No.	Description of the measure	2030	2040	2050
	Installed thermal capacity needed [MW]	**69.63**	**72.67**	**75.80**
1	Replacement of old split AC units with higher EE AC units for small private service and commercial buildings	45.26	47.23	49.27
2	Natural gas DH/CHP (for supermarket, hotel, large private hospitals, large private schools, private service and other commercial buildings)	24.37	25.43	26.53
	Primary energy savings [GWh]	**13.93**	**14.53**	**15.16**
1	Replacement of old split AC units with higher EE AC units for small private service and commercial buildings	9.05	9.45	9.85
2	Natural gas DH/CHP (for supermarket, hotel, large private hospitals, large private schools, private service and other commercial buildings)	4.87	5.09	5.31
	GHG reduction [kton]	**32.60**	**62.59**	**59.22**
1	Replacement of old split AC units with higher EE AC units for small private service and commercial buildings	21.19	40.68	38.49
2	Natural gas DH/CHP (for supermarket, hotel, large private hospitals, large private schools, private service and other commercial buildings)	11.41	21.91	20.73

Source: Calculation carried out by the EECG consulting team

III.5.4 Industry Sector

Industrial enterprises use energy commodities for heating for own use, for non-energy purposes, transport, electricity production and heat production for sale. Fuels used for the last three categories are not part of energy consumption by final users and are usually reported elsewhere in a questionnaire. Fuels used for transport by enterprises are reported in the transport sector in final consumption. The Industry Sector in the National Energy Strategy is divided into several industrial subsectors: Metallurgical Industry; Chemical; Construction Materials; Mining; Food/Beverages/Tobacco; Textiles/Leather/Footwear; Wood/Paper/Printing; Mechanical. The analysis of economic development for the years 2010-2023 shows that, during the transition period, the role and weight of the Industry Sector has suffered a decrease in terms of contribution to national economic development. But at the same time, it is noted that after the political and social transformations, the changes in ownership and management of industrial enterprises, a tendency towards stabilization in a new situation, imposed by the introduction of the market economy, is also being observed.

Breakdown of the respective energy services: 1) low temperature process heating (LTPH); 2) high temperature process heating (HTPH); 3) motive power (MP) and 4) cooling (including space cooling for office and workshops as well as cooling for industrial processes) are presented for baseline scenario.

Breakdown for above mentioned energy services was based on the Strategy of Energy and on the bench mark values based on different studies. The total energy delivered to Albanian's industry sector was modelled down to the level of municipalities, including the following energy commodities in the excel model:

- Coal and lignite;
- Natural gas
- electricity,
- Heavy Fuel Oil
- Diesel,
- Liquefied petroleum gas,
- Firewood,
- Wood pellets / wood chips / briquettes,
- Solar PV Autoproducers,
- Solar energy (solar collectors)
- Energy taken from the environment using heat pumps.

The annual consumption of lignite and the natural gas is included from the model because they do exist in the energy balance and consultant team has assumed their distribution of consumption at the level of municipalities based on the most well-known industrial enterprises reported from INSTAT. Also, the model of delivered energy includes the energy taken from the environment using heat pumps, which is not included in the total 2023 final energy consumption of the household sector according to the Eurostat method. Given that delivered energy in the templates (in Excel file format) consultant team prepared and includes:

- All energy entering the industrial subsectors through the system boundary (coal, natural gas, HFO, electricity, LPG, diesel);
- Renewable energy entering through the system boundary (e.g., wood, pellets);
- Energy from renewable energy sources generated on the site of the building (e.g., electricity generation from roof-top PV Autoproducers systems, heat generated on- site using solar collectors, heat taken from the environment using heat pumps);
- Heat taken from the environment using heat pumps also needs to be included in the balance of delivered energy (as consumption to the industrial sectors as well as). When it comes to heat pumps, only the electricity used to drive compression heat pumps is currently included in the energy balance.

Energy efficiency measures for the Industrial Sector include the replacement of fossil fuels with renewable energy sources, the introduction of more efficient technologies such as very highly efficient stoves with wood/pellets, biomass condensing boilers and heat pumps, as well as the use of solar energy for heating and DHW preparation. The proposed measures are presented in more detail in the tables III-15 including the needs capacities to be installed, as well as the annual savings in delivered energy and CO2 emissions resulting from the implementation of all EE/RES measures have been calculated.

Table III-15: Industrial Sector – Installed capacity needed, annual primary energy and CO2 emissions savings after the implementation of EE/RES measures for efficient space heating

No.	Description of the measure	2030	2040	2050
	Installed thermal capacity needed [MW]	**1097.23**	**1314.50**	**1436.28**
1	Utilisation of waste heat from compressor systems	153.61	184.03	201.08
2	Utilisation of waste heat from furnaces	230.42	276.04	301.62
3	Replacement of old heavy fuel furnaces with new natural efficient furnaces	186.53	223.46	244.17
4	Replacement of fuel oil boilers with modern biomass boilers	197.50	236.61	258.53
5	Replacement of LPG boilers with modern biomass boilers	153.61	184.03	201.08
6	Natural gas DH/CHP (for new districts areas within new industrial areas)	175.56	210.32	229.80
	Primary energy savings [GWh]	**360.63**	**785.23**	**1203.26**
1	Utilisation of waste heat from compressor systems	50.49	109.93	168.46
2	Utilisation of waste heat from furnaces	75.73	164.90	252.69
3	Replacement of old heavy fuel furnaces with new natural efficient furnaces	61.31	133.49	204.55
4	Replacement of fuel oil boilers with modern biomass boilers	64.91	141.34	216.59
5	Replacement of LPG boilers with modern biomass boilers	50.49	109.93	168.46

6	Natural gas DH/CHP (for new districts areas within new industrial areas)	57.70	125.64	192.52
	GHG reduction [kton]	**152.03**	**228.04**	**380.07**
1	Utilisation of waste heat from compressor systems	21.28	31.93	53.21
2	Utilisation of waste heat from furnaces	31.93	47.89	79.81
3	Replacement of old heavy fuel furnaces with new natural efficient furnaces	25.84	38.77	64.61
4	Replacement of fuel oil boilers with modern biomass boilers	27.36	41.05	68.41
5	Replacement of LPG boilers with modern biomass boilers	21.28	31.93	53.21
6	Natural gas DH/CHP (for new districts areas within new industrial areas)	24.32	36.49	60.81

Source: Calculation carried out by the EECG consulting team

Table III-16: Industrial Sector – Installed capacity needed, annual primary energy and CO2 emissions savings after the implementation of EE/RES measures for efficient DHW preparation

No.	Description of the measure	2030	2040	2050
	Installed thermal capacity needed [MW]	**423.95**	**562.88**	**686.81**
1	Replacement of electric boilers with solar collectors	80.55	106.95	130.49
2	Utilisation of waste heat from compressor systems	55.11	73.17	89.29
3	Solar heating combined with heat pumps	84.79	112.58	137.36
4	Installation of solar collectors for DHW preparation (where diesel is currently used as energy product)	63.59	84.43	103.02
5	Installation of solar collectors for DHW preparation (where LPG is currently used as energy product)	72.07	95.69	116.76
6	Natural gas DH/CHP (for new districts areas within new industrial areas)	67.83	90.06	109.89
	Primary energy savings [GWh]	**139.34**	**336.25**	**575.38**
1	Replacement of electric boilers with solar collectors	26.47	63.89	109.32
2	Utilisation of waste heat from compressor systems	18.11	43.71	74.80
3	Solar heating combined with heat pumps	27.87	67.25	115.08
4	Installation of solar collectors for DHW preparation (where diesel is currently used as energy product)	20.90	50.44	86.31
5	Installation of solar collectors for DHW preparation (where LPG is currently used as energy product)	23.69	57.16	97.82
6	Natural gas DH/CHP (for new districts areas within new industrial areas)	22.29	53.80	92.06
	GHG reduction [kton]	**58.74**	**97.65**	**181.74**
1	Replacement of electric boilers with solar collectors	11.16	18.55	34.53
2	Utilisation of waste heat from compressor systems	7.64	12.69	23.63
3	Solar heating combined with heat pumps	11.75	19.53	36.35
4	Installation of solar collectors for DHW preparation (where diesel is currently used as energy product)	8.81	14.65	27.26
5	Installation of solar collectors for DHW preparation (where LPG is currently used as energy product)	9.99	16.60	30.90
6	Natural gas DH/CHP (for new districts areas within new industrial areas)	9.40	15.62	29.08

Source: Calculation carried out by the EECG consulting team

Table III-17: Industrial Sector – Installed capacity needed, annual primary energy and CO2 emissions savings after the implementation of EE/RES measures for efficient space cooling

No.	Description of the measure	2030	2040	2050
	Installed thermal capacity needed [MW]	**38.62**	**53.55**	**67.89**
1	Replacement of old split AC units with higher EE AC units	2.70	3.75	4.75
2	Replacement of old split AC units with central higher EE AC unit	1.93	2.68	3.39
3	Replacement of old cooling chambers with very highly efficient cooling chambers	33.99	47.12	59.75
	Primary energy savings [GWh]	**12.69**	**31.99**	**56.88**
1	Replacement of old split AC units with higher EE AC units	0.89	2.24	3.98
2	Replacement of old split AC units with central higher EE AC unit	0.63	1.60	2.84
3	Replacement of old cooling chambers with very highly efficient cooling chambers	11.17	28.15	50.05
	GHG reduction [kton]	**5.35**	**9.29**	**17.97**

1	Replacement of old split AC units with higher EE AC units	0.37	0.65	1.26
2	Replacement of old split AC units with central higher EE AC unit	0.27	0.46	0.90
3	Replacement of old cooling chambers with very highly efficient cooling chambers	4.71	8.18	15.81

Source: Calculation carried out by the EECG consulting team

III.6 – Cost-Benefit Analysis of the Potential for EE/RES in Heating and Cooling for different sectors

III.6.1 Methodology and Parameter Considered for Cost-Benefit Analysis

After the technical potential was assessed, the next logical step was to undertake a cost-benefit analysis to identify technical solutions which might be more cost-effective than all recognised heating and cooling solutions.

Albania has completed a cost-benefit analysis: for its territory based on climate conditions, economic feasibility and technical suitability, in accordance with **Annex XI of the EED Recast, the EECG evaluated cost-optimal solutions for heating and cooling different options for different sectors, ensuring they are both economically viable and energy efficient. This included comparing baseline and alternative scenarios to identify the most cost-effective measures. EECG team carried out the cost benefit analysis of the economic potential for efficiency in heating and cooling for four sectors: 1. Residential reference buildings, 2. Central and Municipal Public reference buildings, 3. Private Service and Commercial reference buildings, and 4. Industrial subsectors.**

EECG team carried out **cost benefit analysis** of different technologies for heating and cooling covering all four about main sectors in three different climatic zones of Albania based on the requirements of the Article 25(3) **and identified important scenarios: i) baseline scenario based on the Strategy of Energy of Albania for the above mentioned sectors; and ii) efficient and RES heating and cooling supply scenario with much higher penetration compared with NECP-WAM (With Additional Measures) by introducing more efficient and renewable heating and cooling technologies, distinguishing between energy derived from fossil and renewable sources where applicable.**

EECG team checked all following technologies for **four sectors: 1. Residential reference buildings, 2. Central and Municipal Public reference buildings, 3. Private Service and Commercial reference buildings, and 4. Industrial subsectors** based on cost benefit analysis:

(a) Industrial waste heat and cold;
(b) Waste incineration;
(c) High efficiency cogeneration;
(d) Renewable energy sources, such as solar thermal and biomass, other than those used for high efficiency cogeneration (geothermal has very low potential in Albania – however also it will be considered in the analysis);
(e) Heat pumps;
(f) Introducing small district heating for hospital and dormitory centres (reducing heat and cold losses from existing district networks – in Albania very few hospitals centre have district heating);
(g) Introducing new scheme for district heating and cooling and checking the possibility for tree-cogeneration (heating-cooling-electricity);

EECG team carried out the analysis of economic potential based on the following steps and taking in to consideration the following aspects:

(a) Considerations:

(i) The cost-benefit analysis for the purposes of Article 25(3) included the financial analysis that take into consideration socioeconomic and environmental factors performed to assess each EE/RE measure presented above with financial analyses using the most important method of net prese value as a criterion for the assessment;

(ii) The baseline scenario was established under Part I for four sectors according to the Strategy of Energy of Albania approved on August 2018 and NECP approved in Dec 2021 and further developed and calibrating based on the real data collected and calculation carried out under Part I and Part II;

(iii) Energy Efficiency and RES Scenario (alternative scenarios) to the baseline took into account energy efficiency and the renewable energy objectives of Regulation (EU) 2018/1999 as well as the **efficient and RES heating and cooling supply scenario with much higher penetration compared with NECP-WAM (With Additional Measures) by introducing more efficient and renewable heating and cooling technologies.**

(b) EECG team included all following elements on the costs-benefits analysis for all EE, RES technologies by including the following costs and benefits all following elements based on the Albanian latest price for each technology related to:

(i) osts:
— capital costs of plants and equipment;
— capital costs of the associated energy networks;
— variable and fixed operating costs;
— energy prices and energy costs;
— environmental, health and safety costs;
— labour market costs.

(ii) Benefits:
— Value of output to the consumer (heating, cooling and electricity);
— External benefits such as environmental, greenhouse gas emissions and health and safety benefits;
— Labour market effects, energy security and competitiveness, to the extent possible.

(c) EECG team prepared the relevant cost-benefit analysis for efficient DH/CHP and individual heating, hot water and cooling which make technical and financial sense for the Albanian conditions **for four sectors: 1. Residential reference buildings, 2. Central and Municipal Public reference buildings, 3. Private Service and Commercial reference buildings, and 4. Industrial subsectors**.

(d) EECG team defined boundaries and integrated approach based on the three climate zones of Albania and considering all above mentioned **four sectors;**

(i) the geographical boundary covered all above mentioned **four sectors**;
(ii) the cost-benefit analyses took into account all relevant centralised and decentralised supply resources available.

(e) EECG team also considered the following assumptions:

(i) Albanian conditions related to the energy prices for 2025 separately for each **for four sectors**, for the purpose of the cost-benefit analyses.

Whilst some energy prices in Albania are regulated (electricity and natural gas), others are determined by international market forces (petroleum products, coal and fuel wood). According to the Electricity Law, a full opening of the market (with all customers free to choose between alternative suppliers for all consumers connected to 6/10/35 kV) entered in force in 2015.

Figure III-14 presents the electricity tariffs for residential consumers (household and family consumers) from 2015 to 2024, expressed in Euro cents per kWh, including VAT. It is important to note that the electricity price has remained approximately at 9.5 ALL/kWh (excluding VAT) throughout this period. However, the price in Euro cents per kWh has increased (by around 40%) due to the depreciation of the ALL to EUR exchange rate, as recorded by the National Bank of Albania. Additionally, electricity price for residential consumers does not distinguish between off-peak and peak hours.

Figure III-15 presents the electricity tariffs for central and municipal public buildings from 2015 to 2024, expressed in Euro cents per kWh, including VAT. It is important to note that the electricity price has remained approximately at 16.4 ALL/kWh (excluding VAT) throughout this period. However, the price in Euro cents per kWh has increased (by around 31%) due to the depreciation of the ALL to EUR exchange rate, as recorded by the National Bank of Albania. Public consumers pay different rates depending on off-peak and peak periods. The prices shown in Figure III-16 are average prices, taking into account both off-peak and peak periods.

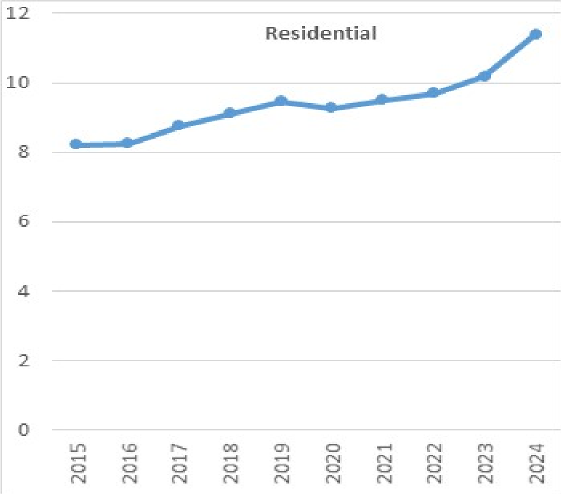


Figure III-14: Residential electricity price expressed in Euro cent/kWh incl. VAT in Albania

Source: Prepared by the Consultant based on yearly ERE Reports and average yearly exchange rate

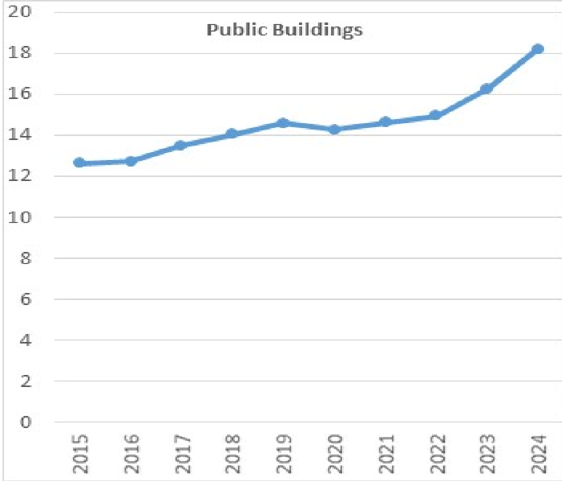


Figure III-15: Public Buildings electricity price expressed in Euro cent/kWh incl. VAT in Albania

Source: Prepared by the Consultant based on yearly ERE Reports and average yearly exchange rate

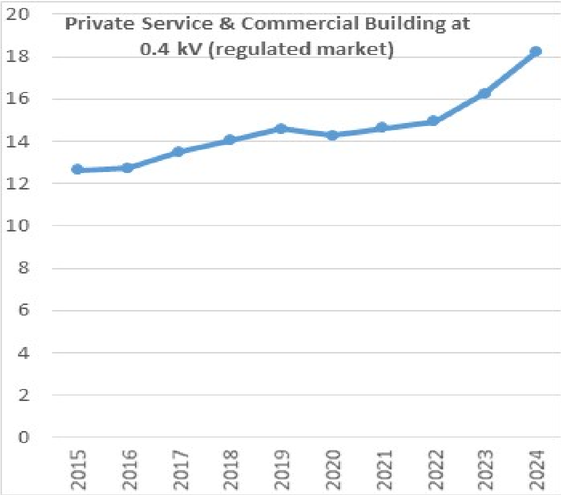


Figure III-16: Private services & commercial & industry (at 0.4 kV) electricity price expressed in Euro cent/kWh incl. VAT in Albania

Source: Prepared by the Consultant based on yearly ERE Reports and average yearly exchange rate

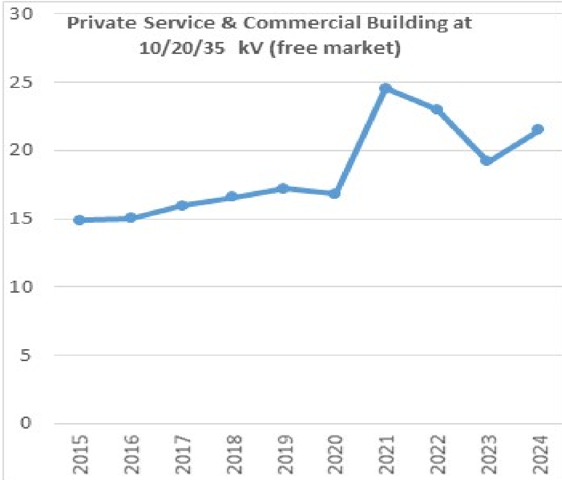


Figure III-17: Private services & commercial (at 10/20/35 kV) & industry electricity price expressed in Euro cent/kWh incl. VAT in Albania

Source: Prepared by the Consultant based on yearly ERE Reports and average exchange rate

Figure III-17 presents the electricity tariffs for private service and commercial buildings and industry supplied at a voltage level of 0.4 kV (regulated market) from 2015 to 2024, expressed in Euro cents per kWh, including VAT. It is important to note that the electricity price has remained approximately at 16.6 ALL/kWh (excluding VAT) throughout this period. However, the price in Euro cents per kWh has increased (by around 31 %) due to the depreciation of the ALL to EUR exchange rate, as recorded by the National Bank of Albania. Private service and commercial building customers pay different rates depending on off-peak and peak periods. The prices shown in Figure III-16 are average prices, considering both off-peak and peak periods.

Figure III-17 presents the electricity tariffs for private service and commercial buildings and industry supplied at voltage levels of 6/10/20/35 kV (free market) from 2015 to 2024, expressed in Euro cents per kWh, including VAT. It is important to note that electricity prices increased (by around 32%) in 2021, 2022, and 2023 due to high energy commodity prices, including electricity. Private service and commercial building customers pay different rates depending on off-peak and peak periods. The prices shown in Figure III-17 are average prices, considering both off-peak and peak periods.

Figure III-18 shows a comparison of electricity prices between Albania and other countries in the region. It is important to note that if taxes were included, the price difference would be even greater, as many EU countries impose taxes on electricity for households. The electricity tariff for residential customers in Albania is at the level of most Western Balkan countries, except North Macedonia.

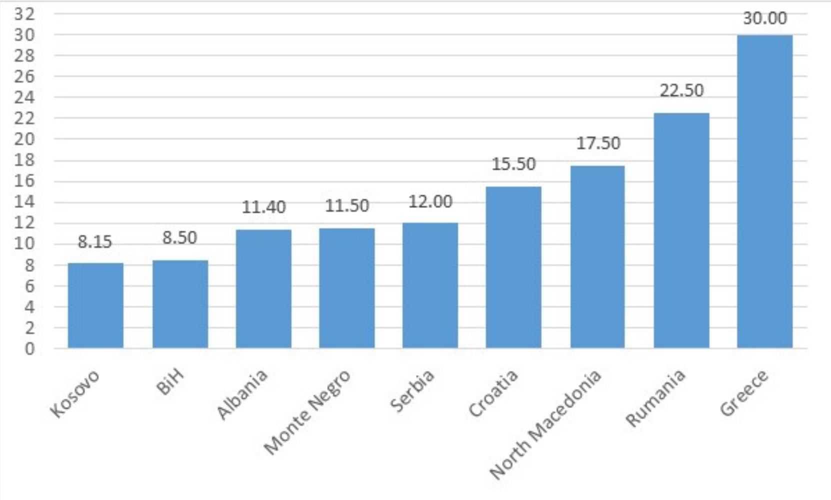


Figure III-18: Electricity tariff including VAT for residential consumers, €cent/kWh, 2024
Source: Prepared by the Consultant based on yearly ERE Reports (2024)

Table III-18 below presents the energy commodities prices for the residential sector (household consumers, family consumers). Prices for fuel wood vary widely due to quality, water content and caloric heating value. Price differences appear also between urban areas and rural areas where self-collection firewood is still common. Prices for oil by-products, pellets and fuel wood presented below are average prices of several municipalities according to Smart Energy Municipalities Project (Shkodra, Korca, Permet and Berat). Prices for large consumers are 12-15% lower than for residential consumers. Prices for diesel and LPG are comparable with prices in the region and EU. Coal in Albania is almost all imported and used mostly in building materials processing industry and very little in commercial buildings. The low price of coal can also be partly explained by the proximity of the market (Kosovo, North Macedonia and Montenegro).

Table III-18: Energy prices including VAT for residential consumers

Energy commodities	Residential energy prices	Energy Commodities Commercial Units	Energy Price, Euro cent/kWh
Coal	185	Euro/ton	4.97
Diesel	1.81	Euro/litre	16.88
LPG	0.99	Euro/kg	11.96
Pellets	300.00	Euro/ton	5.51
Fuel Wood	70.00	Euro/m3	3.77
Electricity		Euro cent/kWh	11.40
Solar Energy	0.00	Euro cent/kWh	0.00

Source: Prepared by the Consultant based on surveys of the actual energy commodities prices in 2024

Table III-19 below presents the energy commodities prices of the Central and Municipal Public Buildings, Private Service & Commercial Building at 0.4 kV (regulated market) Energy Price as well as Private Service & Commercial Building at 10/20/35 kV (free market) Energy Price.

Table III-19: Energy prices including VAT for Central and Municipal Public as well as Private Service & Commercial `Buildings

Energy commodities	Energy prices	Energy Commodities Commercial Units	Central and Municipal Public Buildings	Private Service & Commercial Building at 0.4 kV	Private Service & Commercial Building at 10/20/35 kV (free	Industry at 10/20/35 kV (free market)

			Energy Price, Euro cent/kWh	(regulated market) Energy Price, Euro cent/kWh	market) Energy Price, Euro cent/kWh	Energy Price, Euro cent/kWh
Coal	175.75	Euro/ton	4.72			
Diesel	1.72	Euro/litre	16.04			
LPG	0.94	Euro/kg	11.36			
Pellets	285.00	Euro/ton	5.23			
Fuel Wood	65.00	Euro/m3	3.50			
Electricity		Euro cent/kWh	18.21	18.21	21.49	21.49
Solar Energy	0.00	Euro cent/kWh	0.00			

Source: Prepared by the consultant team based on surveys of actual energy commodities prices

The above stated energy commodity prices, together with the forecasted prices for the period 2025-2050, will be the bases for carrying out the cost benefit analysis of EE/RES measures in the building stock.

(ii) The discount rate used in the economic analysis to calculate net present value will be chosen according to European or national guidelines;

(iii) EECG team will use national forecast based on the approved Strategy of Energy and NECP taking into account the European or international energy price development forecasts;

(iv) EECG team has great experience taking in the account the prices used in the economic analysis and will reflect socio-economic costs and benefits. External costs, such as environmental and health effects will be included to the extent possible, namely when a market price exists or when it is already included in European or national regulation.

(f) EECG team carried out the sensitivity analysis as follows versus the most important parameters which have direct impact in the CBA: i. heating and cooling demand for each sector; ii. Energy prices for each sector, iii. Total investment unit costs for each EE/RES technology proposed for each sector; iv. Discount/interest rate for each EE/RES technology proposed for each sector.

The Consultant carried out the cost-benefit analysis of various heating and cooling technologies, including renewable energy sources, waste heat recovery, high-efficiency DHs and cogeneration. The Cost-Benefit Analysis (CBA) considered socioeconomic, environmental, and financial factors, using the Net Present Value (NPV) as the primary financial criterion, followed by Levelized Discount Cost (LDC), Internal Rate of Return (IRR) and Pay Back Period (PBP). The financial formulas most wide used include NPV and IRR, and their respective calculations are given in formula 1 and 2.

$$NPV = \sum_{t=0}^{30} \frac{B_t}{(1+r_t)^t} - \sum_{t=0}^{30} \frac{C_t}{(1+r_t)^t} \qquad (1)$$

$$NPV = \sum_{t=0}^{30} \frac{B_t}{(1+IRR)^t} - \sum_{t=0}^{30} \frac{C_t}{(1+IRR)^t} = 0 \qquad (2)$$

Where:
t → the period of the cash flow: varying from 0 (year of installation) to n (the last year equal to lifetime;
rt → the nominal discount rate (for the purpose of such financial analysis; 6-9% (it must also be noted that a sensitivity analysis has also been made) based on the reference values recommended by different Banks in Albania. In the sensitivity analysis, where variation of NPV is compared to rt, reference is made to the interval (6-9%);
Bt → profits accrued under the Project, which are obtained by multiplying the energy savings (including the unit of heat and cool sold) by the price of energy source for each year;
Ct → initial investment (only C_O) and the operating cost of the Project, which is obtained by multiplying the energy savings by the price of energy source for each year.

Albania has in the past experience in the part related to six large CHP and DH schemes serving primary to industry and secondary to public building and some areas of the residential sector in the following cities of Albania: Tirana, Korca, Kucova, Cerrik, Maliq, Fier, Elbasan. All these ex-six large CHP and DH schemes have been operating with very old inefficient technologies based on coal and only Fier was based on the residual fuel oil and they stopped operating due to long years of operating (closed on years 1992-2000), high environmental impact and reduced/closed down of the industrial customers.

The basic argument in favour of a CHP is that it should be possible to obtain a worthwhile overall advantage by local generation of electricity, and at the same time make used of about two-thirds of the waste heat. Other specific benefits can be detailed as follows:

5. Improved Albanian National Energy Efficiency and Preservation of Fossil Fuels Reserves (non-renewable energy).
6. Local Generation of Heat, Cooling and Electricity based on RES technologies according to the demand of each customer for four above mentioned sectors that will be analysed.
7. Reduction in Environmental Pollution and GHG emissions based on RES technologies according to the demand of each customer for four above mentioned sectors that will be analysed.
8. Investment in Industry (more jobs) and Service Sector by investing in the most promising technology of CHP based on RES technologies according to the demand of each customer for four above mentioned sectors that will be analysed.

III.6.2 First EE/RES Specific Investment Considered for Cost-Benefit Analysis

Capital expenditures for EE/RES heating and cooling systems include the funds necessary for the implementation of an individual technology. In the context of heating and cooling, certain equipment will differ from case to case: equipment for heat generation/recycling, pumps (in individual systems), pipelines for heat transfer in centralised systems, boilers and all other systems. The cost of investment into measures related to decentralised (individual) systems have been taken from the database used for the LTBRAP of energy efficiency measures specifying unit prices and total prices of the renovation of multi-apartment buildings and public buildings and the study entitled determining minimum requirements for energy performance of buildings. The cost of investment into measures related to centralised systems have been estimated by experience and based on the data received from heat producers/suppliers. Both have been shown in Table III-20.

Table III-20: Overview of specific costs of investment by EE/RES technology (CAPEX)

No.	Technology	Cost of investment [Euro/kW]
	Investment for decentralised (individual) systems	
1	Fuel oil boilers	143
2	LPG boilers	143
3	Natural gas boilers	150
4	Firewood boilers	165
5	Modern biomass boilers	154
6	Heat pumps	634
7	Solar collectors	718
8	Natural gas micro-CHP	793
	Investment for centralised systems	
9	Fuel oil boilers	109
10	Natural gas boilers	109
11	Natural gas cogeneration	905
12	Biomass boilers	109
13	High-efficiency natural gas cogeneration	1,149
14	Water-to-water compression heat pump	571
15	Geothermal plant with plate and pipe heat exchanger for geothermal heat exploitation	2,963
16	Solar collectors	718
17	Waste heat recovery systems for Industrial Plants	2,083
18	Waste incinerators	1,652

Source: EECG survey in the Albanian Market and calibrated with Croatian Programmes of Exploiting Heating and Cooling Efficiency Potentials

BAU scenario provides for the regular replacement of the currently used heat generation equipment, since service lives of certain capacities are to end during the observation period. Replacement rate has been determined based on the expected service life of technologies, which is 20 years in most cases. Thus, a 5% annual replacement rate has been used, except in the cases in which it has been assumed that replacement of the entire capacity is necessary, where the total replacement has been linearly distributed over the observation period.

Construction period: Time required for plant construction should be specified in order to distribute the cost over the time required to complete the construction of an individual system. In order to simplify the analysis, a one- year period is assumed as the construction period for all individual system technologies. In the case of DHS, a longer period has been foreseen, so the installation of heat generation and preparation of transmission & distribution costs have been distributed over more years, depending on the technology used.

III.6.3 Operation and Maintenance EE/RES Considered for Cost-Benefit Analysis

Operational costs refer to the consumption of material, maintenance, administration, cost of labour, maintenance, etc. They can be fixed or variable.
Fixed costs of maintenance and management (OPEX) include labour, insurance, regular maintenance and routine replacement of plant components, such as boilers, carburettors, raw material handling equipment, etc. Replacement parts and additional servicing costs constitute the greatest share of **variable costs** of management and maintenance. These can also include other costs, such as the cost of biomass ash management. In this analysis, due to their nature and limited data availability, the variable costs of management and maintenance for individual systems have been estimated jointly with the fixed costs. In the case of DHS, fixed and variable costs of management and maintenance have been considered separately. Under the alternative scenario, the share of OPEX in CAPEX technologies ranges between 0.14% (solar collectors) and 23.44% (modern biomass boilers). In the case of DHS, this share is significantly lower, primarily due to the economies of scale, so it ranges between 0.14% (solar collectors) and 3.68% (biomass boilers).

Fixed costs of management and maintenance are calculated by multiplying the installed capacity of the observed technology by fixed costs of individual technology expressed in [Euro/kW].In the case of DHS, variable costs of maintenance are calculated by multiplying the annual energy consumption of the drive energy product for the observed technology by variable costs of individual technology expressed in [Euro/kW].In the case of DHS, variable costs of maintenance are calculated by multiplying the annual energy consumption of the drive energy product for the observed technology by variable costs of individual technology expressed in [Euro/kW].The specific values of fixed and variable costs of maintenance applied for individual technology in decentralised (individual) and centralised systems are provided in Table III-21.

Table III-21: Overview of maintenance costs of individual technologies (OPEX)

No.	System type	Technology	Fixed maintenance costs [Euro/kW]	Variable maintenance costs [Euro/kWh]
	Decentralised system	Room-based firewood stoves	6.636	0.000
1		Firewood boilers	13.272	0.000
2		Natural gas condensing boilers	15.927	0.000
3		Natural gas boilers	15.927	0.000
4		LPG boilers	15.927	0.000
5		Fuel oil boilers	23.890	0.000
6		Modern biomass boilers	33.446	0.000
7		Heat pumps	15.927	0.000
8		Electric resistance heating	0.133	0.000
		Individual electric boilers	0.133	0.000
9		Individual compression cooling units	13.272	0.000
10		Central compression cooling unit	15.927	0.000
11		Solar collectors	1.327	0.000
12		Natural gas micro-CHP	31.853	0.000
13		Heating substation within the building	0.265	0.000
14	Central systems	Solar collectors	1.327	0.000
15		Water-to-water compression heat pump	3.955	0.000
16		Heat exchanger for industrial waste heat utilisation	7.300	0.013
17		Waste heat utilisation heat exchanger	7.300	0.013
18		Heat exchanger for geothermal heat utilisation	7.300	0.013
19		Fuel oil boilers	3.318	0.000
20		Natural gas boilers	2.966	0.000
21		Natural gas and fuel oil blocks	3.318	0.000
22		Natural gas and gas oil blocks	3.318	0.000
23		Natural gas cogeneration	5.973	0.005
24		High-efficiency natural gas cogeneration	5.309	0.005

25		High-efficiency, biomass cogeneration	6.636	0.007
26		DHS pipeline distribution – HRK/m	6.921	0.000

Source: EECG survey in the Albanian Market and calibrated with Croatian Programmes of Exploiting Heating and Cooling Efficiency Potentials

III.6.4 Cost of CO2 emissions Considered for Cost-Benefit Analysis

Costs of energy products are determined separately. The total amount is derived by multiplying total energy consumption, expressed in MW, with the relative price of a specific energy product, multiplied by 1 000. The prices of energy products and CO2 emissions that have been used can be found in Table III-22. The table shows a lower and a higher price. The price of CO2 emissions has been taken from the European Commission. The data have been corrected, taking into account the actual price trends. Given that the chosen methodology of assessing the cost-effectiveness of each measure (net present value) requires data for costs and benefits for each year of the period under observation, and based on the known values of unit prices of energy products and CO2 emissions in 2023, 2030 and 2050, linear interpolation was applied to determine unit prices in the remaining years of the period covered by the analysis.

Table III-22: The price of CO2 emissions has been taken from the European Commission[9]

Unit prices of energy and CO2 emissions	2023	2030		20250	
	Price emission of CO2 [Euro/tonne CO_2]	Higher Price emission of CO2 [Euro/tonne CO_2]	Higher Price emission of CO2 [Euro/tonne CO_2]	Lower Price emission of CO2 [Euro/tonne CO_2]	Higher Price emission of CO2 [Euro/tonne CO_2]
Natural gas	24.44	65.26	97.57	91.03	147.24
Fuel oil	24.44	65.26	97.57	91.03	147.24
Fuel oil – medium	24.44	65.26	97.57	91.03	147.24
Wood chips	24.44	65.26	97.57	91.03	147.24
Wood pellets	24.44	65.26	97.57	91.03	147.24
Biogas	24.44	65.26	97.57	91.03	147.24
Electricity	24.44	65.26	97.57	91.03	147.24
Industrial waste heat	24.44	65.26	97.57	91.03	147.24

III.6.5 Results of the Cost-Benefit Analysis for Residential Sector

Electricity, LPG and Firewood are largely in use in households as drive energy products and the main financial Cost-Benefit Analysis for all EE/RES space heating technologies for the residential sector are presented at the table III-23.

Table III-23: Cost-benefits financial and economic EE/RES measures for the residential space heating

Nr	Description of the measure	2023–2050		2023–2050	
		FNPV (MEuro)	FIRR (%)	ENPV (MEuro)	EIRR (%)
1	Replacement of traditional biomass stoves with modern highly efficient biomass stoves (base case)	24.216	19.28%	35.723	23.77%
	Replacement of traditional biomass stoves with modern highly efficient biomass stoves (sensitivity case: investments 20% lower)	29.25	24.10%	38.46	28.84%
	Replacement of traditional biomass stoves with modern highly efficient biomass stoves (sensitivity case: investments 20% higher)	19.18	16.16%	32.99	20.54%
2	Replacement of traditional biomass boilers with heat pumps (base case)	63.344	15.87%	111.188	20.25%
	Replacement of traditional biomass boilers with heat pumps (sensitivity case: investments 20% lower)	84.28	19.71%	122.55	24.21%

[9] https://ec.europa.eu/eurostat/databrowser/view/nrg_pc_205/default/table?lang=en

	Replacement of traditional biomass boilers with heat pumps (sensitivity case: investments 20% higher)	42.41	13.32%	99.82	17.68%
3	Solar heating combined with heat pumps (base case)	49.208	17.57%	68.346	20.50%
	Solar heating combined with heat pumps (sensitivity case: investments 20% lower)	61.77	21.88%	77.08	24.93%
	Solar heating combined with heat pumps (sensitivity case: investments 20% higher)	36.65	14.74%	59.61	17.64%
4	Replacement of room-based wood-fired centralised space heating with wood-fired district space heating (base case)	78.852	20.02%	113.545	24.54%
	Replacement of room-based wood-fired centralised space heating with wood-fired district space heating (sensitivity case: investments 20% lower)	94.03	25.08%	121.79	29.88%
	Replacement of room-based wood-fired centralised space heating with wood-fired district space heating (sensitivity case: investments 20% higher)	63.67	16.77%	105.30	21.16%
5	Replacement of fuel oil boilers with modern biomass boilers (base case)	11.722	26.88%	14.830	31.81%
	Replacement of fuel oil boilers with modern biomass boilers (sensitivity case: investments 20% lower)	13.08	34.35%	15.57	39.84%
	Replacement of fuel oil boilers with modern biomass boilers (sensitivity case: investments 20% higher)	10.36	22.28%	14.09	26.92%
6	Replacement of fuel oil boilers with heat pumps (base case)	16.338	25.62%	21.000	30.46%
	Replacement of fuel oil boilers with heat pumps (sensitivity case: investments 20% lower)	18.38	32.61%	22.11	37.96%
	Replacement of fuel oil boilers with heat pumps (sensitivity case: investments 20% higher)	14.30	21.28%	19.89	25.86%
7	Replacement of LPG boilers with modern biomass boilers (base case)	4.764	21.36%	6.615	25.95%
	Replacement of LPG boilers with modern biomass boilers (sensitivity case: investments 20% lower)	5.57	26.85%	7.05	31.77%
	Replacement of LPG boilers with modern biomass boilers (sensitivity case: investments 20% higher)	3.95	17.86%	6.18	22.29%
8	Replacement of LPG boilers with heat pumps (base case)	80.782	19.31%	119.057	23.79%
	Replacement of LPG boilers with heat pumps (sensitivity case: investments 20% lower)	97.53	24.14%	128.15	28.88%
	Replacement of LPG boilers with heat pumps (sensitivity case: investments 20% higher)	64.03	16.18%	109.96	20.56%
9	Increase in the share of heat pumps vs. electric resistance heating (base case)	23.740	11.88%	81.153	16.26%
	Increase in the share of heat pumps vs. electric resistance heating (sensitivity case: investments 20% lower)	48.86	14.74%	94.79	19.10%
	Increase in the share of heat pumps vs. electric resistance heating (sensitivity case: investments 20% higher)	-1.38	9.91%	67.51	14.37%
10	Natural gas DH/CHP (for new districts areas within cities with MABs & Single villas with high heat density) (base case)	10.882	12.86%	28.000	17.23%
	Natural gas DH/CHP (for new districts areas within cities with MABs & Single villas with high heat density) (sensitivity case: investments 20% lower)	18.37	15.95%	32.07	20.33%

	Natural gas DH/CHP (for new districts areas within cities with MABs & Single villas with high heat density) (sensitivity case: investments 20% higher)	3.39	10.76%	23.93	15.18%

Source: Calculation carried out by the EECG consulting team

Main financial Cost-Benefit Analysis for all EE/RES water heating technologies for the residential sector are presented at the table III-24.

Table III-24: Cost-benefits financial and economic EE/RES measures for the residential water heating

Nr	Description of the measure	2023–2050		2023–2050	
		FNPV (MEuro)	FIRR (%)	ENPV (MEuro)	EIRR (%)
1	Replacement of electric boilers with solar collectors (base case)	57.791	12.95%	145.883	17.32%
	Replacement of electric boilers with solar collectors (sensitivity case: investments 20% lower)	96.34	16.06%	166.81	20.44%
	Replacement of electric boilers with solar collectors (sensitivity case: investments 20% higher)	19.24	10.83%	124.95	15.25%
2	Replacement of traditional biomass boilers with heat pumps (base case)	4.819	12.49%	13.566	16.86%
	Replacement of traditional biomass boilers with heat pumps (sensitivity case: investments 20% lower)	8.65	15.49%	15.64	19.86%
	Replacement of traditional biomass boilers with heat pumps (sensitivity case: investments 20% higher)	0.99	10.43%	11.49	14.87%
3	Solar heating combined with heat pumps (base case)	0.360	10.75%	2.562	15.17%
	Solar heating combined with heat pumps (sensitivity case: investments 20% lower)	1.32	13.37%	3.09	17.73%
	Solar heating combined with heat pumps (sensitivity case: investments 20% higher)	-0.60	8.93%	2.04	13.46%
4	Installation of solar collectors for DHW preparation (where diesel is currently used as energy product) (base case)	-0.619	6.53%	0.250	11.31%
	Installation of solar collectors for DHW preparation (where diesel is currently used as energy product) (sensitivity case: investments 20% lower)	0.24	0.46	8.38%	12.95%
	Installation of solar collectors for DHW preparation (where diesel is currently used as energy product) (sensitivity case: investments 20% higher)	-1.00	5.21%	0.04	10.19%
5	Installation of solar collectors for DHW preparation (where LPG is currently used as energy product) (base case)	0.889	16.90%	1.459	21.30%
	Installation of solar collectors for DHW preparation (where LPG is currently used as energy product) (sensitivity case: investments 20% lower)	1.14	1.59	21.02%	25.59%
	Installation of solar collectors for DHW preparation (where LPG is currently used as energy product) (sensitivity case: investments 20% higher)	0.64	14.18%	1.32	18.54%
6	Natural gas DH/CHP (for new districts areas within cities with MABs & Single villas with high heat density) (base case)	7.125	13.12%	17.383	17.49%
	Natural gas DH/CHP (for new districts areas within cities with MABs & Single villas with high heat density) (sensitivity case: investments 20% lower)	11.61	19.82	16.27%	20.66%
	Natural gas DH/CHP (for new districts areas within cities with MABs & Single villas with	2.64	10.98%	14.95	15.39%

	high heat density) (sensitivity case: investments 20% higher)				

Source: Calculation carried out by the EECG consulting team

Main financial Cost-Benefit Analysis for all EE/RES space cooling technologies for the residential sector are presented at the table III-25.

Table III-25: Cost-benefits financial and economic EE/RES measures for the residential space cooling

Nr	Description of the measure	2023–2050		2023–2050	
		FNPV (MEuro)	FIRR (%)	FNPV (MEuro)	FIRR (%)
1	Replacement of old split AC units with higher EE AC units (base case)	57.791	12.95%	145.883	17.32%
	Replacement of old split AC units with higher EE AC units (sensitivity case: investments 20% lower)	105.03	15.54%	189.15	19.92%
	Replacement of old split AC units with higher EE AC units (sensitivity case: investments 20% higher)	13.01	10.47%	139.19	14.91%
2	Replacement of old split AC units with central higher EE AC unit (base case)	4.819	12.49%	13.566	16.86%
	Replacement of old split AC units with central higher EE AC unit (sensitivity case: investments 20% lower)	20.75	12.79%	54.21	17.16%
	Replacement of old split AC units with central higher EE AC unit (sensitivity case: investments 20% higher)	-15.85	8.51%	34.34	13.08%

Source: Calculation carried out by the EECG consulting team

The implementation of the described measures will result in a significant reduction of fossil fuel consumption and, consequently, in greenhouse gas emissions too. Whenever technically feasible, fossil fuel stoves and boilers are to be replaced with renewable energy sources and more efficient technologies such as heat pumps.
Based on the cost-benefit analysis, the **measure of replacing individual firewood stoves** with very efficient stoves and central firewood boilers up to 2030 proved to be cost-effective (FNPV > 0 and ENPV > 0).

Furthermore, the **measure involving the replacement of central firewood boilers** with central modern biomass boilers for space heating and DHW preparation also proved be cost-effective (FNPV > 0 and ENPV > 0). Moreover, modern biomass has a somewhat higher CO_2 emissions factor than firewood.
The measure involving central firewood boiler replacement with heat pumps also proved to be cost-effective (FNPV > 0 and ENPV > 0).

Under the proposed measures in the household sector, **a complete cessation of fuel oil use** as a drive energy product for space heating and DHW preparation is foreseen by 2030. The measures propose the replacement of existing fuel oil-fired sources of heat with modern biomass boilers and heat pumps, and installation of solar collectors notably for the purpose of DHW preparation. All proposed measures of replacing fuel oil-fired sources of thermal energy for space heating and DHW preparation are cost-effective without support (FNPV > 0 and ENPV > 0). The result is expected given that fuel oil is an environmentally unacceptable energy product with a high CO_2 emissions factor compared to modern biomass or electricity. Furthermore, the price per unit of fuel oil is considerably higher than modern biomass price. Where heat pumps are used, the decisive element is, naturally, the fact that heat pump efficiency (SPF) is considerably higher than that of fuel oil-fired thermal energy sources. The **replacement of direct electric resistance space heating** with compression heat pumps in the household sector is definitely cost-effective (FNPV > 0 and ENPV > 0) in view of a considerably higher efficiency (SPF) of heat pumps compared to electric resistance space heating.

And finally, where household DHW preparation is concerned, it is important to prepare domestic hot water efficiently using solar collectors, heat pumps, biomass boilers integrate with solar panels and the latest one to be A+ electric boilers.

III.6.6 Results of the Cost-Benefit Analysis for Central and Municipal Public Buildings Sector

Main financial Cost-Benefit Analysis for all EE/RES water heating technologies for the Public Service Building Stock are presented at the Table III-26.

Table III-26: Cost-benefits financial and economic EE/RES measures for the Public Service Building Stock space heating

No.	Description of the measure	2023–2050		2023–2050	
		FNPV (MEuro)	FIRR (%)	ENPV (MEuro)	EIRR (%)
1	Replacement of traditional biomass stoves with modern highly efficient biomass stoves (base case)	3.437	20.07%	4.942	24.60%
	Replacement of traditional biomass stoves with modern highly efficient biomass stoves (sensitivity case: investments 20% lower)	4.10	25.14%	5.30	29.95%
	Replacement of traditional biomass stoves with modern highly efficient biomass stoves (sensitivity case: investments 20% higher)	2.78	16.81%	4.58	21.21%
2	Replacement of traditional biomass boilers with heat pumps (base case)	5.347	14.60%	10.531	18.96%
	Replacement of traditional biomass boilers with heat pumps (sensitivity case: investments 20% lower)	7.62	18.10%	11.76	22.54%
	Replacement of traditional biomass boilers with heat pumps (sensitivity case: investments 20% higher)	3.08	12.24%	9.30	16.62%
3	Solar heating combined with heat pumps (base case)	1.539	12.28%	4.588	16.66%
	Solar heating combined with heat pumps (sensitivity case: investments 20% lower)	2.87	15.24%	5.31	19.60%
	Solar heating combined with heat pumps (sensitivity case: investments 20% lower)	0.20	10.26%	3.86	14.70%
4	Replacement of room-based wood-fired centralised space heating with wood-fired district space heating (base case)	0.736	11.75%	2.643	16.14%
	Replacement of room-based wood-fired centralised space heating with wood-fired district space heating (sensitivity case: investments 20% lower)	1.57	14.59%	3.10	18.95%
	Replacement of room-based wood-fired centralised space heating with wood-fired district space heating (sensitivity case: investments 20% higher)	-0.10	9.80%	2.19	14.27%
5	Replacement of fuel oil boilers with modern biomass boilers (base case)	0.731	16.81%	1.206	21.21%
	Replacement of fuel oil boilers with modern biomass boilers (sensitivity case: investments 20% lower)	0.94	20.90%	1.32	25.46%
	Replacement of fuel oil boilers with modern biomass boilers (sensitivity case: investments 20% higher)	0.52	14.10%	1.09	18.46%
6	Replacement of fuel oil boilers with heat pumps (base case)	1.452	13.06%	3.587	17.42%
	Replacement of fuel oil boilers with heat pumps (sensitivity case: investments 20% lower)	2.39	16.19%	4.09	20.57%
	Replacement of fuel oil boilers with heat pumps (sensitivity case: investments 20% higher)	0.52	10.93%	3.08	15.34%
7	Replacement of LPG boilers with modern biomass boilers (base case)	0.819	19.12%	1.215	23.60%

	Replacement of LPG boilers with modern biomass boilers (sensitivity case: investments 20% lower)	1.57	14.59%	3.10	18.95%
	Replacement of LPG boilers with modern biomass boilers (sensitivity case: investments 20% higher)	0.65	16.02%	1.12	20.41%
8	Replacement of LPG boilers with heat pumps (base case)	2.329	18.42%	3.549	22.88%
	Replacement of LPG boilers with heat pumps (sensitivity case: investments 20% lower)	0.94	20.90%	1.32	25.46%
	Replacement of LPG boilers with heat pumps (sensitivity case: investments 20% higher)	1.80	15.45%	3.26	19.82%
9	Increase in the share of heat pumps vs. electric resistance heating (base case)	8.369	21.01%	11.723	25.57%
	Increase in the share of heat pumps vs. electric resistance heating (sensitivity case: investments 20% lower)	2.39	16.19%	4.09	20.57%
	Increase in the share of heat pumps vs. electric resistance heating (sensitivity case: investments 20% higher)	6.90	17.57%	10.93	21.99%
10	Natural gas DH/CHP (for primary hospitals, regional hospitals, large central and municipal public buildings with high heat density) (base case)	3.750	11.95%	12.479	16.33%
	Natural gas DH/CHP (for primary hospitals, regional hospitals, large central and municipal public buildings with high heat density) (sensitivity case: investments 20% lower)	7.57	14.83%	14.55	19.19%
	Natural gas DH/CHP (for primary hospitals, regional hospitals, large central and municipal public buildings with high heat density) (sensitivity case: investments 20% higher)	-0.07	9.97%	10.41	14.43%

Source: Calculation carried out by the EECG consulting team

Main financial Cost-Benefit Analysis for all EE/RES water heating technologies for the Public Service Building Stock are presented at the table III-27.

Table III-27: Cost-benefits financial and economic EE/RES measures for the Public Service Building Stock water heating

No.	Description of the measure	2023–2050		2023–2050	
		FNPV (MEuro)	FIRR (%)	ENPV (MEuro)	EIRR (%)
1	Replacement of electric boilers with solar collectors (base case)	1.452	13.06%	3.587	17.42%
	Replacement of electric boilers with solar collectors (sensitivity case: investments 20% lower)	11.66	20.37%	16.62	24.90%
	Replacement of electric boilers with solar collectors (sensitivity case: investments 20% higher)	6.23	13.75%	13.67	18.11%
2	Replacement of traditional biomass boilers with heat pumps (base case)	0.819	19.12%	1.215	23.60%
	Replacement of traditional biomass boilers with heat pumps (sensitivity case: investments 20% lower)	1.40	22.55%	27.20%	1.89
3	Solar heating combined with heat pumps (base case)	2.329	18.42%	3.549	22.88%
	Solar heating combined with heat pumps (sensitivity case: investments 20% lower)	0.26	20.45%	0.37	24.99%
	Solar heating combined with heat pumps(sensitivity case: investments 20% higher)	0.14	13.81%	0.30	18.17%

4	Installation of solar collectors for DHW preparation (where diesel is currently used as energy product) (base case)	8.369	21.01%	11.723	25.57%
	Installation of solar collectors for DHW preparation (where diesel is currently used as energy product) (sensitivity case: investments 20% lower)	9.08	21.60%	13.11	26.20%
	Installation of solar collectors for DHW preparation (where diesel is currently used as energy product) (sensitivity case: investments 20% higher)	0.65	16.02%	1.12	20.41%
5	Installation of solar collectors for DHW preparation (where LPG is currently used as energy product) (base case)	3.750	11.95%	12.479	16.33%
	Installation of solar collectors for DHW preparation (where LPG is currently used as energy product) (sensitivity case: investments 20% lower)	5.30	18.10%	15.46	22.54%
	Installation of solar collectors for DHW preparation (where LPG is currently used as energy product) (sensitivity case: investments 20% higher)	1.80	15.45%	3.26	19.82%
6	Natural gas DH/CHP (for primary hospitals, regional hospitals, large central and municipal public buildings with high heat density) (base case)	6.044	19.42%	8.854	23.91%
	Natural gas DH/CHP (for primary hospitals, regional hospitals, large central and municipal public buildings with high heat density) (sensitivity case: investments 20% lower)	8.38	14.23%	10.79	18.59%
	Natural gas DH/CHP (for primary hospitals, regional hospitals, large central and municipal public buildings with high heat density) (sensitivity case: investments 20% higher)	-0.07	9.97%	10.41	14.43%

Source: Calculation carried out by the EECG consulting team

Main financial Cost-Benefit Analysis for all EE/RES space cooling technologies the Public Service Building Stock are presented at the table III-28.

Table III-28: Cost-benefits financial and economic EE/RES measures for the Public Service Building Stock space cooling

No.	Description of the measure	2023–2050		2023–2050	
		FNPV (MEuro)	FIRR (%)	FNPV (MEuro)	FIRR (%)
1	Replacement of old split AC units with higher EE AC units for small municipal public buildings (base case)	4.286	12.76%	11.281	17.13%
	Replacement of old split AC units with higher EE AC units for small municipal public buildings (sensitivity case: investments 20% lower)	7.35	15.82%	12.94	20.20%
	Replacement of old split AC units with higher EE AC units for small municipal public buildings (sensitivity case: investments 20% higher)	1.23	10.67%	9.62	15.10%
2	Replacement of old split AC units with central higher EE AC unit for large municipal public buildings (base case)	6.071	19.49%	8.892	23.99%
	Replacement of old split AC units with higher EE AC units for small municipal public buildings (sensitivity case: investments 20% lower)	7.31	24.38%	9.56	29.14%
	Replacement of old split AC units with higher EE AC units for small municipal public buildings (sensitivity case: investments 20% higher)	4.84	16.33%	8.22	20.72%

Source: Calculation carried out by the EECG consulting team

A complete cessation of fuel oil use as a drive energy product for space heating and DHW preparation is foreseen in the service sector by 2030 under the proposed measures. The measures propose the replacement of existing fuel oil-fired sources of heat with modern biomass boilers and heat pumps, and the installation of solar collectors notably for the purpose of DHW preparation (in service sector buildings where technically feasible and justified). All proposed measures of replacing fuel oil-fired sources of thermal energy for space heating and DHW preparation are cost- effective without support (FNPV > 0 and ENPV > 0). The result is expected given that fuel oil is an environmentally unacceptable energy product with a high CO_2 emissions factor compared to modern biomass or electricity. Furthermore, the price per unit of fuel oil is considerably higher than modern biomass price. Where heat pumps are used, the decisive element is, naturally, the fact that heat pump efficiency (SPF) is considerably higher than that of fuel oil-fired thermal energy sources.

A **complete cessation of fuel oil use** as a drive energy product for DHW preparation is foreseen by 2030. The measures propose the replacement of existing LPG-fuelled boilers as sources of heat with modern biomass boilers and heat pumps, and installation of solar collectors notably for DHW preparation (in service sector buildings where technically feasible and justified). All proposed measures of replacing LPG-fuelled thermal energy sources for space heating and DHW preparation are also cost-effective in the service sector without support (FNPV > 0 and ENPV > 0).

The measure involving solar collector installation for DHW preparation is cost-effective (FNPV > 0 and ENPV > 0) for the whole period under observation.

The measure involving natural gas boiler replacement with natural gas micro-CHP for space heating in the service sector is cost-effective with public support (FNPV > 0 and ENPV > 0) for the whole period under observation.

The replacement of natural gas boilers with heat pumps for space heating and DHW preparation in the service sector is cost-effective (FNPV > 0 and ENPV > 0) in both periods under observation. The decisive element here is a considerably higher efficiency if heat pumps (which, similar to condensing boilers, are a low-temperature heat source, more efficient in lower temperature regimes or at lower flow/return water temperatures within the heating system) are used.

The **replacement of direct electric resistance space heating** in the service sector with heat pumps is a cost-effective measure without support (FNPV > 0 and ENPV > 0) for the whole period under observation in view of a considerably higher efficiency (SPF) of heat pumps compared to electric resistance space heating.

Similarly, to the household sector, it is important to prepare domestic hot water efficiently in the service sector too, it is important to prepare domestic hot water efficiently using solar collectors, heat pumps, biomass boilers integrate with solar panels and the latest one to be A+ electric boilers.

III.6.7 Results of the Cost-Benefit Analysis for Private Service and Commercial Building Sector

Main financial Cost-Benefit Analysis for all EE/RES water heating technologies for the Private Service and Commercial Building Sector are presented at the table III-29.

Table III-29: Cost-benefits financial and economic EE/RES measures for the Private Service and Commercial Building Sector for meeting space heating energy demand

No.	Description of the measure	2023–2050		2023–2050	
		FNPV (MEuro)	FIRR (%)	ENPV (MEuro)	EIRR (%)
1	Replacement of traditional biomass stoves with modern highly efficient biomass stoves (base case)	10.953	20.42%	15.591	24.95%
	Replacement of traditional biomass stoves with modern highly efficient biomass stoves (sensitivity case: investments 20% lower)	12.98	25.60%	16.69	30.43%
	Replacement of traditional biomass stoves with modern highly efficient	8.92	17.09%	14.49	21.50%

	biomass stoves (sensitivity case: investments 20% higher)				
2	Replacement of traditional biomass boilers with heat pumps (base case)	35.255	19.73%	51.234	24.23%
	Replacement of traditional biomass boilers with heat pumps (sensitivity case: investments 20% lower)	42.25	24.69%	55.03	29.47%
	Replacement of traditional biomass boilers with heat pumps (sensitivity case: investments 20% higher)	28.26	16.53%	47.44	20.92%
3	Solar heating combined with heat pumps (base case)	15.466	17.27%	24.865	21.68%
	Solar heating combined with heat pumps (sensitivity case: investments 20% lower)	19.58	21.50%	27.10	26.09%
	Solar heating combined with heat pumps(sensitivity case: investments 20% higher)	11.35	14.49%	22.63	18.85%
4	Replacement of room-based wood-fired centralised space heating with wood-fired district space heating (base case)	5.966	13.15%	14.486	17.51%
	Replacement of room-based wood-fired centralised space heating with wood-fired district space heating (sensitivity case: investments 20% lower)	9.69	16.30%	16.51	20.69%
	Replacement of room-based wood-fired centralised space heating with wood-fired district space heating (sensitivity case: investments 20% higher)	2.24	11.00%	12.46	15.42%
5	Replacement of fuel oil boilers with modern biomass boilers (base case)	3.989	22.04%	5.453	26.66%
	Replacement of fuel oil boilers with modern biomass boilers (sensitivity case: investments 20% lower)	4.63	27.75%	5.80	32.73%
	Replacement of fuel oil boilers with modern biomass boilers (sensitivity case: investments 20% higher)	3.35	18.41%	5.11	22.86%
6	Replacement of fuel oil boilers with heat pumps (base case)	0.571	23.38%	0.760	28.08%
	Replacement of fuel oil boilers with heat pumps (sensitivity case: investments 20% lower)	0.65	29.56%	0.80	34.67%
	Replacement of fuel oil boilers with heat pumps (sensitivity case: investments 20% higher)	0.49	19.49%	0.71	23.99%
7	Replacement of LPG boilers with modern biomass boilers (base case)	2.603	19.40%	3.823	23.89%
	Replacement of LPG boilers with modern biomass boilers (sensitivity case: investments 20% lower)	3.14	24.26%	4.11	29.02%
	Replacement of LPG boilers with modern biomass boilers (sensitivity case: investments 20% higher)	2.07	16.26%	3.53	20.64%
8	Replacement of LPG boilers with heat pumps (base case)	5.835	16.86%	9.594	21.26%
	Replacement of LPG boilers with heat pumps (sensitivity case: investments 20% lower)	7.48	20.97%	10.49	25.54%
	Replacement of LPG boilers with heat pumps (sensitivity case: investments 20% higher)	4.19	14.15%	8.70	18.51%
9	Increase in the share of heat pumps vs. electric resistance heating (base case)	31.512	23.51%	41.851	28.21%
	Increase in the share of heat pumps vs. electric resistance heating (sensitivity case: investments 20% lower)	36.04	29.73%	34.85%	44.31

	Increase in the share of heat pumps vs. electric resistance heating (sensitivity case: investments 20% higher)	26.99	19.59%	39.40	24.09%
10	Natural gas DH/CHP (for primary hospitals, regional hospitals, large central and municipal public buildings with high heat density) (base case)	20.498	13.37%	47.760	17.74%
	Natural gas DH/CHP (for primary hospitals, regional hospitals, large central and municipal public buildings with high heat density) (sensitivity case: investments 20% lower)	32.43	16.58%	54.24	20.97%
	Natural gas DH/CHP (for primary hospitals, regional hospitals, large central and municipal public buildings with high heat density) (sensitivity case: investments 20% higher)	8.57	11.20%	41.28	15.60%

Source: Calculation carried out by the EECG consulting team

Main financial Cost-Benefit Analysis for all EE/RES water heating technologies for the Private Service and Commercial Building Sector are presented at the table III-30.

Table III-30: Cost-benefits financial and economic EE/RES measures for the Private Service and Commercial Building Sector for meeting the water heating energy demand

No.	Description of the measure	2023–2050		2023–2050	
		FNPV (MEuro)	FIRR (%)	ENPV (MEuro)	EIRR (%)
1	Replacement of electric boilers with solar collectors (base case)	49.880	22.21%	67.931	26.84%
	Replacement of electric boilers with solar collectors (sensitivity case: investments 20% lower)	57.78	27.99%	72.22	32.99%
	Replacement of electric boilers with solar collectors (sensitivity case: investments 20% higher)	41.98	18.55%	63.64	23.01%
2	Replacement of traditional biomass boilers with heat pumps (base case)	7.845	23.08%	10.500	27.76%
	Replacement of traditional biomass boilers with heat pumps (sensitivity case: investments 20% lower)	9.01	29.15%	11.13	34.24%
	Replacement of traditional biomass boilers with heat pumps (sensitivity case: investments 20% higher)	6.68	19.25%	9.87	23.73%
3	Solar heating combined with heat pumps (base case)	6.181	16.86%	10.164	21.26%
	Solar heating combined with heat pumps (sensitivity case: investments 20% lower)	7.92	20.97%	11.11	25.54%
	Solar heating combined with heat pumps (sensitivity case: investments 20% higher)	4.44	14.15%	9.22	18.51%
4	Installation of solar collectors for DHW preparation (where diesel is currently used as energy product) (base case)	3.814	20.13%	5.475	24.65%
	Installation of solar collectors for DHW preparation (where diesel is currently used as energy product) (sensitivity case: investments 20% lower)	4.54	25.22%	5.87	30.03%
		3.09	16.85%	5.08	21.25%
5	Installation of solar collectors for DHW preparation (where LPG is currently used as energy product) (base case)	1.898	19.27%	2.801	23.76%
	Installation of solar collectors for DHW preparation (where LPG is currently used as energy product) (sensitivity case: investments 20% lower)	2.29	24.09%	3.02	28.84%
	Installation of solar collectors for DHW preparation (where LPG is currently used	1.50	16.15%	2.59	20.53%

	as energy product) (sensitivity case: investments 20% higher)				
6	Natural gas DH/CHP (for primary hospitals, regional hospitals, large central and municipal public buildings with high heat density) (base case)	2.533	13.37%	5.903	17.74%
	Natural gas DH/CHP (for primary hospitals, regional hospitals, large central and municipal public buildings with high heat density) (sensitivity case: investments 20% lower)	4.01	16.58%	6.70	20.97%
	Natural gas DH/CHP (for primary hospitals, regional hospitals, large central and municipal public buildings with high heat density) (sensitivity case: investments 20% higher)	1.06	11.20%	5.10	15.60%

Source: Calculation carried out by the EECG consulting team

Main financial Cost-Benefit Analysis for all EE/RES space cooling technologies the Private Service and Commercial Building Sector are presented at the table III-31.

Table III-31: Cost-benefits financial and economic EE/RES measures for the Private Service and Commercial Building Sector for meeting the space cooling energy demand

No.	Description of the measure	2023–2050		2023–2050	
		FNPV (MEuro)	FIRR (%)	FNPV (MEuro)	FIRR (%)
1	Replacement of old split AC units with higher EE AC units for small municipal public buildings (base case)	3.041	10.02%	9.279	14.48%
	Replacement of old split AC units with higher EE AC units for small municipal public buildings (sensitivity case: investments 20% lower)	4.08	12.50%	11.47	16.87%
	Replacement of old split AC units with higher EE AC units for small municipal public buildings (sensitivity case: investments 20% higher)	3.09	16.85%	5.08	21.25%
2	Replacement of old split AC units with central higher EE AC unit for large municipal public buildings (base case)	4.335	12.45%	12.322	16.82%
	Replacement of old split AC units with central higher EE AC unit for large municipal public buildings (sensitivity case: investments 20% lower)	7.83	15.44%	14.22	19.81%
	Replacement of old split AC units with central higher EE AC unit for large municipal public buildings (sensitivity case: investments 20% higher)	1.50	16.15%	2.59	20.53%

Source: Calculation carried out by the EECG consulting team

It is important to point out that all EE/RES measures for the Private Service and Commercial Building Sector are more positive from financial point of view compare with Central and Municipal Public Building stock.

III.6.8 Results of the Cost-Benefit Analysis for Industry Sector

The proposed measures are presented in more detail in the tables III-32 – III-34 including the needs capacities to be installed, as well as the annual savings in delivered energy and CO_2 emissions resulting from the implementation of all EE/RES measures for industry sector have been calculated. It is important to point out that all EE/RES measures for Industrial Sector have positive from financial point of view.

Table III-32: Industrial Sector – Installed capacity needed, annual primary energy and CO2 emissions savings after the implementation of EE/RES measures for efficient space heating

No.	Description of the measure	2023–2050		2023–2050	
		FNPV (MEuro)	FIRR (%)	ENPV (MEuro)	EIRR (%)
1	Utilisation of waste heat from compressor systems (base case)	38.255	11.16%	189.291	15.56%
	Utilisation of waste heat from compressor systems (sensitivity case: investments 20% lower)	104.34	13.86%	225.17	18.22%
	Utilisation of waste heat from compressor systems (sensitivity case: investments 20% higher)	-27.83	9.28%	153.41	13.79%
2	Utilisation of waste heat from furnaces (base case)	60.268	11.21%	286.821	15.62%
	Utilisation of waste heat from furnaces (sensitivity case: investments 20% lower)	159.40	13.93%	340.64	18.29%
	Utilisation of waste heat from furnaces (sensitivity case: investments 20% higher)	-38.87	9.33%	233.00	13.84%
3	Replacement of old heavy fuel furnaces with new natural efficient furnaces (base case)	36.000	22.04%	49.217	26.66%
	Replacement of old heavy fuel furnaces with new natural efficient furnaces (sensitivity case: investments 20% lower)	41.78	27.75%	52.36	32.73%
	Replacement of old heavy fuel furnaces with new natural efficient furnaces (sensitivity case: investments 20% higher)	30.22	18.41%	46.08	22.86%
4	Replacement of fuel oil boilers with modern biomass boilers (base case)	51.750	25.00%	67.097	29.80%
	Replacement of fuel oil boilers with modern biomass boilers (sensitivity case: investments 20% lower)	58.47	31.76%	70.74	37.04%
	Replacement of fuel oil boilers with modern biomass boilers (sensitivity case: investments 20% higher)	45.03	20.79%	63.45	25.34%
5	Replacement of LPG boilers with modern biomass boilers (base case)	30.769	21.38%	42.706	25.96%
	Replacement of LPG boilers with modern biomass boilers (sensitivity case: investments 20% lower)	35.99	26.87%	45.54	31.80%
	Replacement of LPG boilers with modern biomass boilers (sensitivity case: investments 20% higher)	25.55	17.87%	39.87	22.30%
6	Natural gas DH/CHP (for new districts areas within new industrial areas) (base case)	44.464	12.11%	139.698	16.49%
	Natural gas DH/CHP (for new districts areas within new industrial areas) (sensitivity case: investments 20% lower)	86.14	15.03%	162.32	19.40%
	Natural gas DH/CHP (for new districts areas within new industrial areas) (sensitivity case: investments 20% higher)	2.79	10.11%	117.07	14.57%

Source: Calculation carried out by the EECG consulting team

Table III-33: Industrial Sector – Installed capacity needed, annual primary energy and CO2 emissions savings after the implementation of EE/RES measures for efficient DHW preparation

No.	Description of the measure	2023–2050		2023–2050	
		FNPV (MEuro)	FIRR (%)	ENPV (MEuro)	EIRR (%)
1	Replacement of electric boilers with solar collectors (base case)	60.046	17.84%	93.845	22.27%
	Replacement of electric boilers with solar collectors (sensitivity case: investments 20% lower)	74.84	22.23%	101.88	26.87%
	Replacement of electric boilers with solar collectors (sensitivity case: investments 20% higher)	45.26	14.97%	85.82	19.33%
2	Utilisation of waste heat from compressor systems (base case)	16.986	11.16%	84.051	15.56%

	Utilisation of waste heat from compressor systems (sensitivity case: investments 20% lower)	46.33	13.86%	99.98	18.22%
	Utilisation of waste heat from compressor systems (sensitivity case: investments 20% higher)	-12.36	9.28%	68.12	13.79%
3	Solar heating combined with heat pumps (base case)	95.013	23.41%	126.414	28.11%
	Solar heating combined with heat pumps (sensitivity case: investments 20% lower)	108.75	29.59%	133.87	34.71%
	Solar heating combined with heat pumps (sensitivity case: investments 20% higher)	81.27	19.51%	118.95	24.01%
4	Installation of solar collectors for DHW preparation (where diesel is currently used as energy product) (base case)	14.325	21.92%	19.635	26.53%
	Installation of solar collectors for DHW preparation (where diesel is currently used as energy product) (sensitivity case: investments 20% lower)	16.65	27.59%	20.90	32.56%
	Installation of solar collectors for DHW preparation (where diesel is currently used as energy product) (sensitivity case: investments 20% higher)	12.00	18.31%	18.37	22.76%
5	Installation of solar collectors for DHW preparation (where LPG is currently used as energy product) (base case)	19.375	24.30%	25.393	29.05%
	Installation of solar collectors for DHW preparation (where LPG is currently used as energy product) (sensitivity case: investments 20% lower)	22.01	30.80%	26.82	36.00%
	Installation of solar collectors for DHW preparation (where LPG is currently used as energy product) (sensitivity case: investments 20% higher)	16.74	20.22%	23.96	24.75%
6	Natural gas DH/CHP (for new districts areas within new industrial areas) (base case)	15.217	11.52%	60.757	15.92%
	Natural gas DH/CHP (for new districts areas within new industrial areas) (sensitivity case: investments 20% lower)	35.14	14.31%	71.58	18.67%
	Natural gas DH/CHP (for new districts areas within new industrial areas) (sensitivity case: investments 20% higher)	-4.71	9.60%	49.94	14.08%

Source: Calculation carried out by the EECG consulting team

Table III-34: Industrial Sector – Installed capacity needed, annual primary energy and CO2 emissions savings after the implementation of EE/RES measures for efficient space cooling

No.	Description of the measure	2023–2050		2023–2050	
		FNPV (MEuro)	FIRR (%)	FNPV (MEuro)	FIRR (%)
1	Replacement of old split AC units with higher EE AC units (base case)	0.543	12.80%	1.417	17.17%
	Replacement of old split AC units with higher EE AC units (sensitivity case: investments 20% lower)	0.93	15.87%	1.62	20.25%
	Replacement of old split AC units with higher EE AC units (sensitivity case: investments 20% higher)	0.16	10.70%	1.21	15.13%
2	Replacement of old split AC units with central higher EE AC unit (base case)	0.830	13.68%	1.840	18.04%
	Replacement of old split AC units with central higher EE AC unit (sensitivity case: investments 20% lower)	1.27	16.96%	2.08	21.37%
	Replacement of old split AC units with central higher EE AC unit (sensitivity case: investments 20% higher)	0.39	11.46%	1.60	15.86%

3	Replacement of old cooling chambers with very highly efficient cooling chambers (base case)	22.416	14.13%	46.652	18.49%
	Replacement of old cooling chambers with very highly efficient cooling chambers (sensitivity case: investments 20% lower)	33.02	17.52%	52.41	21.94%
	Replacement of old cooling chambers with very highly efficient cooling chambers (sensitivity case: investments 20% higher)	11.81	11.84%	40.89	16.23%

Source: Calculation carried out by the EECG consulting team

Part IV - POTENTIAL NEW STRATEGIES AND POLICY MEASURES

IV.1 Removing the Barriers for boosting EE/RES Investments for meeting energ demand for Heating and Cooling

IV.1.1 Residential Building Stock

Table IV-1 presents the summary of the barriers of implementing EE/RES measures together with the respective remedies and responsible institutions for the residential sector.

Table IV-1: Summary of the barriers of implementing EE/RES measures with the respective remedies for the residential sector

Economic	**Institutional**
✓ **Barrier RE1**: Market distortions in local energy markets mean that the prices of some energy commodities do not reflect their production/generation / transmission / distribution costs (e.g., firewood, and electricity). ✓ **Impact**: Consumers underestimate the monetary value of energy savings and make economically incorrect choices. ✓ **Remedy**: Commission a 'National Wood Energy Action Plan' to examine the case for increased wood energy production and utilization. Regulate secondary (local) fuel markets and introduce taxes or levies to cover shortfall between the actual price and the cost reflective price. ✓ **Responsibility**: MIE, MoF, MT&E ERE.	✓ **Barrier RI1**: Many households adhere to traditional methods of cooking and space and water heating, because of preference, lack of awareness or in some very remote areas, where some hours in the year power cuts exists, for security of supply reasons. ✓ **Impact**: Use of inefficient (and possibly unsafe) equipment, inappropriate choice of fuels, deforestation. ✓ **Remedy**: Implementation of educational campaigns; subsidized schemes to trade in inappropriate or inefficient equipment for superior models; improve quality of supply. ✓ **Responsibility**: EEA, Central and Municipalities Institutions.
Legal and Regulatory	**Financial**
✓ **Barrier RLR1**: Since 1990, many new 'illegal' buildings have been constructed without the required building permission. ✓ **Impact**: Buildings are constructed in an unplanned way, standards are not enforced and the development of gas networks, DH schemes may be hindered. Energy performance is not monitored or enforced and often results in excessive energy consumption. ✓ **Remedy**: Increase the capacity of municipalities to process building permits following strictly good path	✓ **Barrier RF1**: Inability to access the loan market. Absence of affordable EE/RES financing schemes for lower income households. ✓ **Impact**: Low level of investment in EE/RES in the residential sector, even in high value measures. The high EE/RES potential of the residential sector is not realized especially in MAB sub-category. ✓ **Remedy**: Develop scheme for MIE/EEA to provide EE improvement grants or subsidized loans with backing of IFIs.

for the whole period 2015-2024, through e-Albania platform. ✓ **Responsibility**: MIE, Municipalities, EEA.	✓ **Responsibility**: Commercial Banks, IFIs and donors in cooperation with MIE/EEA.
✓ **Barrier RLR2**: Home Owners Associations-HOAs are not being established due to a lack of secondary legislation and current structures to deal with 'common areas' in buildings are ineffective. ✓ **Impact**: Improvement loans are not being taken in MAB sub-category and savings are not being realized, the building envelope of joint dwellings continues to deteriorate. ✓ **Remedy**: Secondary legislation is needed to encourage the establishment of HOAs that represent the interests of all occupants and that can deliver improvements in the quality of buildings. Establish special funds to assist the establishment and HOAs. ✓ **Responsibility**: MIE, Municipalities, EEA.	✓ **Barrier RF2**: Electricity commercial losses and non-payment of energy bills. ✓ **Impact**: No incentive to spend money on implementing EE/RES measures if energy is not paid for. ✓ **Remedy**: Install secure e-net metering, OSHEE supported by ERE and EEA to develop schemes that reward good payers, e.g., by providing technical and financial assistance with EE/RES improvements in their homes. ✓ **Responsibility**: OSHEE ERE and EEA.
✓ **Barrier RLR3**: Electricity tariffs are (a) not yet fully cost-reflective, tariffs are subsidized and some inefficient tariff structures persist (e.g., Tariff for customers with low fixed charges amount/consumer/month, which are based on the 'evaluated consumption' and not in peak capacity absorbed from the network). ✓ **Impact**: EE energy savings are undervalued, reducing incentives and making loans more difficult to repay. ✓ **Remedy**: Short-term, make subsidies conditional on implementation of EE /RES measures: medium-term phase out subsidies, ERE is phasing in cost-reflective tariffs and Time of Use tariff structures. ✓ **Responsibility**: MIE, ERE, EEA.	

Source: Prepared by the EECG consulting team

IV.1.2 Public Building Stock

Table IV-2 presents the summary of the barriers of implementing EE/RES measures together with the respective remedies and responsible institutions for the central and municipal public building stock.

Table IV-2: Summary of the barriers of implementing EE/RES measures with the respective remedies for the public building sub-sector

Economic	Institutional
✓ Barrier PE1: **EE is not a top priority for municipality mayors - water supply, waste disposal, sewage treatment is considered more important.** ✓ Impact: **Any available funds are spent on other projects, even though EE /RES programs can have a better ROI than other priorities.** ✓ Remedy: **Set up dedicated funding facilities which can only be used for EE related investments.** ✓ Responsibility: **IFIs, EEA, Municipalities.**	✓ Barrier PI1: **There is insufficient EE /RES expertise and insufficient resources at municipal level.** ✓ Impact: **Municipal EE planning and implementation are constrained and municipalities cannot deliver good quality EE /RES plans.** ✓ Remedy: **Consider changing the basis for EE /RES planning to a regional level (e.g., based on stronger involvement of Municipalities and the Albanian Development Fund with its regional structures all over Albania). TA to provide training to municipalities and to assist with setting up of EE/RES planning support facility at regional level.** ✓ Responsibility: **IFIs, EEA, municipalities.**
Legal and Regulatory	**Financial**

✓ Barrier PLR1: **Budgetary rules do not allow municipalities to benefit from any energy savings they achieve in the longer term – whilst other national grants to municipalities are awarded according to set formulae, each year's budget allocation for utility bills is based on the previous year's outturn. Any savings achieved in energy costs may not be used to finance investments.** ✓ Impact: **Reduced incentive to invest in EE/RES measures. Barrier to operation of ESCOs.** ✓ Remedy: **Research possibility of making changes to the municipal budget setting process or of circumventing this constraint.** ✓ Responsibility: **MIE, MoF.**	✓ Barrier PF1: **The Law on Public Debt imposes various restrictions on municipalities' ability to borrow money, principally the need to have two consecutive years of unqualified accounts.** ✓ Impact: **Cash strapped municipalities cannot borrow in order to finance EE projects.** ✓ Remedy: **Deliver funds to municipalities via other channels, such as central government (via appropriate ministries) until borrowing criteria met.** ✓ Responsibility: **IFIs, MoF, MIE, EEA.**
✓ Barrier PLR2: **Energy savings may be deferred due to compliance with Technical Regulation, which states that 'energy sustainability' requires achievement of planned comfort levels in public buildings, as well as meeting EE, RES and CO2 reduction respective targets.** ✓ Impact: **Achieving comfort levels in some public buildings may initially increase energy consumption and energy costs, even if accompanied by implementation of EE measures; ESCO type arrangements cannot be applied in such a situation.** ✓ Remedy: **Develop schemes to provide financial assistance to help public buildings meet minimum legal comfort levels.** ✓ Responsibility: **IFIs, Ministries, municipalities.**	✓ Barrier PF2: **Central government budgetary constraints limit investment opportunities., particularly in the current economic climate.** ✓ Impact: **Central government cannot finance EE projects.** ✓ **Remedy:** Secure funding from IFIs. ✓ **Responsibility:** IFIs, MoF, MIE, EEA.
✓ Barrier PLR3: **The Law on Public Procurement requires government tenders to take account of positive EE related aspects and they shall use LCC methodology for selection of bidders. But it is not being implemented because the necessary secondary legislation not in place.** ✓ Impact: **Tenders are evaluated purely on the basis of gross cost and the value of the energy saving potential of bids is ignored.** ✓ Remedy: **The secondary legislation required to implement the amendments to the Public Procurement Law has to be drafted and enforced. MEI supported from the WB finalized the secondary legislation, which is approved by the Council of Ministers and actually MEI/PPA are finalizing the LCC methodology and the respective tool.** ✓ Responsibility: **MoF, PPA and EEA.**	

Source: Prepared by the EECG consulting team

IV.1.3 SMEs - Private Services and Industrial Enterprises

Table IV-3 presents the summary of the barriers of implementing EE/RES measures together with the respective remedies and responsible institutions for the SMEs for Private Service and Commercial Building Stock as well as SMEs for Industrial enterprises.

Table IV-3: Summary of the barriers of implementing EE/RES measures with the respective remedies for SMEs

Economic	Institutional
✓ **Barrier CE1**: Underdeveloped local EE business infrastructure. SMEs tend to operate individually, except on an ad hoc basis when there is a perceived need to collaborate. ✓ **Impact**: The fragmented nature of the private sector prevents strong private-public partnerships or the	✓ **Barrier CI1**: Inadequate data and institutional capacity to monitor, verify and evaluate the impact of EE/RES programs. ✓ **Impact**: Lack of information on the effectiveness of EE/RES investments and for evaluating future investments.

formation of clusters to deliver services, leading to a lack of commercial and professional expertise to implement EE measures; discourages ESCOs. ✓ **Remedy**: Support local businesses in identifying/developing EE/RES market capabilities. ✓ **Responsibility**: EEA, CoIC (Chamber of Industry and Commerce), EE/RES companies.	✓ **Remedy**: TA for EEA and municipal energy offices. ✓ **Responsibility**: IFIs, Local Banks, EEA, Municipalities.
✓ **Barrier CE2**: Absence of ESCOs and ESCO based schemes from the local market. ✓ **Impact**: Customers will have to secure up-front capital in order to finance EE investments. ✓ **Remedy**: Develop confidence in the EE market: create demand, make finance for EE/RES measures more easily available, standardize contracts, support M&V procedures, revise public procurement rules to accommodate ESCO type arrangements. ✓ **Responsibility**: EEA, CoIC, EE/RES companies.	✓ **Barrier CI2**: Lack of impartial, professional detailed technical information concerning EE investments. ✓ **Impact**: Potential customers are not well positioned to make informed decisions and either make wrong decisions or are put off from investing. Lack of surveys on the quality of EE /RES services and products means customers do not feel confident about making EE related decisions. ✓ **Remedy**: TA for EEA to establish an independent advisory body that will assist potential customers in their decision making. ✓ **Responsibility**: EEA, CoIC.
	✓ **Barrier CI3**: Lack of a comprehensive and reliable EE data base. ✓ **Impact**: Poor quality of decision making leading to ineffective investments. ✓ **Remedy**: Donors to instigate a major long-term project in partnership with the INSTAT to develop a data base as required, including a long-term load research program. ✓ **Responsibility**: IFIs, EEA, INSTAT.
	✓ **Barrier CI4**: Lack of donor coordination on current and future EE issues. ✓ **Impact**: Replication of effort, lack of focus, conflict, confusion. ✓ **Remedy**: Strengthen EEA so it can take a leading role and establish a regular EE/RES forum for all interested parties. ✓ **Responsibility**: IFIs, MIE, EEA.
Legal and Regulatory	**Financial**
✓ **Barrier CLR1**: The Albania Energy Efficiency Agency is newly established and under resourced relative to its responsibilities and obligations. ✓ **Impact**: EEA could fail to meet its obligations under the Energy Community Treaty and the Law on Energy Efficiency. ✓ **Remedy**: Expansion of financial resources - especially given support for pilot projects and TA for training. ✓ **Responsibility**: IFIs, MIE, EEA.	✓ **Barrier CF1**: High level of transaction costs (in terms of both money and time) for EE investments. ✓ **Impact**: Prohibitively high transaction costs will discourage EE/RES investments. ✓ **Remedy**: Streamline the process - develop EE /RES delivery financial mechanisms for each market segment (residential-single home, residential-vulnerable families, residential-MABs, public central and municipality buildings, private service and commercial buildings), standardize common financing deals, combine smaller size projects, etc. ✓ **Responsibility**: Commercial Banks, IFIs.
✓ **Barrier CLR2**: The Draft Law on Energy Performance in Buildings laid down procedures for setting up a national fund to promote EE and RES projects. ✓ **Impact**: The absence of a fund specifically dedicated to implementation of EE/RES measures means that loans will be used to invest in what are perceived to be higher priorities. ✓ **Remedy**: Explore ways in which a dedicated fund could be set up, the existing legislation amended or other existing mechanisms tailored to the requirements of investment in EE /RES. ✓ **Responsibility**: MoF, MIE.	✓ **Barrier CF2**: Lack of funding for energy auditors and energy audits. ✓ **Impact**: EE programs in the residential sector (approximately 640,000 residential buildings, 10,000 public and commercial buildings, 85,000 private service and commercial buildings) may be constrained by a lack of energy auditors. In other sectors potential EE/RES projects will not progress beyond the initial evaluation stage. ✓ **Remedy**: In the medium-term, energy auditors will be self-employed on commercial terms. In the short-term, EEA will have to secure funding from the MIE/MoF to pay auditors to work on its projects. ✓ **Responsibility**: EEA, MIE, MoF.

Source: Prepared by the EECG consulting team

IV.2 Proposed Financial Models for boosting EE/RES Investment for meeting energ demand for Heating and Cooling

IV.2.1 Residential Building Stock

Traditional financial models for EE/RES improvements in residential buildings often rely on upfront cost-benefit analysis, which can be a barrier to adoption due to high initial costs and perceived long payback periods. Here are some alternative financial models that can overcome these challenges and encourage wider uptake of EE/RES measures:

- Pay-As-You-Save (PAYS)
- On-Bill Financing (OBF)
- Energy Service Companies (ESCOs)
- Energy Performance Contracting (EPC)
- Performance-Based Contracting (PBC)
- Property Assessed Clean Energy (PACE) Financing
- Shared Savings Agreements (SSA)
- Green Bonds
- White Bonds
- Carbon Offset Programs
- Energy Efficiency Certificates (EECs)
- Indirect EE financial models for residential sector
- Direct EE financial models for the residential sector

EE/RES financial models in bold are the most important ones and are analyzed in detail in the following session.

IV.2.1.1 On-Bill Financing (OBF)

This model integrates financing for EE/RES upgrades with the customer's monthly energy bill. Customers simply add a financing charge to their existing bill, making the process seamless and transparent.

OBF model for the renovation of the residential sector is not considered suitable for Albania. Here are some specific reasons:

- Lack of legal framework: Currently, there is no clear legal framework in Albania for implementing the OBF model. Legislation is needed to define the roles and responsibilities of all actors involved in the program, including financial institutions, end-users, and public utilities.
- Insufficient regulatory capacity: Regulating the OBF model requires an active role from the regulator to oversee financial institutions and protect consumers. Currently, there are concerns about the capacity of the regulator in Albania to effectively perform this role.
- Limited liquidity: The financial sector in Albania may have limited liquidity to finance a large number of OBF projects, which could limit the availability of financing for users.
- Risk aversion: Financial institutions may be risk-averse towards financing the renovation of older housing stock, which could lead to limited participation in the OBF program.
- Insufficient data on building condition: There is a lack of reliable data on the condition of residential buildings in Albania, which makes it difficult to assess energy efficiency and renovation costs.
- Low affordability: A significant part of the population of Albania has low affordability, which could make it difficult to pay for OBF instalments.

IV.2.1.2 Energy Service Companies (ESCOs)

ESCOs offer comprehensive energy-saving solutions to building owners, encompassing audits, financing, design, installation, and maintenance of EE upgrades. They guarantee energy savings and share the risks and rewards, making them attractive for large-scale projects. **ESCO offers a promising approach on long-term for financing and implementing energy efficiency upgrades in residential buildings (especially for MABs) in Albania.** EEA's involvement could significantly contribute to the success of this approach by addressing financial, technical, and awareness-related challenges. EEA, as a leading future EE Fund in Albania, could play a crucial role in providing financial support for ESCO projects. This could include direct funding, loan guarantees, or technical assistance grants. Positive reasons for using ESCO for residential building renovations in Albania, potentially including EE/RES as an intermediary:

- Reduced upfront costs: ESCOs typically finance the upfront costs of energy efficiency upgrades, allowing homeowners to avoid large initial investments. EEF could potentially provide financial guarantees or loans to ESCOs, making projects even more accessible.
- Guaranteed performance: ESCOs are typically contracted to achieve specific energy savings, ensuring that the project delivers expected results. EEA's involvement could add further credibility and assurance to the performance guarantees.

However, it's important to consider some potential challenges:

- Market maturity: The ESCO market in Albania is still developing, and finding qualified ESCOs with experience in residential buildings might be challenging.
- Regulatory environment: Clear regulations and standards for ESCO contracts and performance guarantees are crucial for market confidence.

IV.2.1.3 Indirect EE/RES financial models for residential sector

IV.2.1.3.1 Single Houses

This EE/RES financial models for residential sector involves the exclusive participation of local commercial banks, offering loans with a preferential interest rate lower than the current market rate. Most refurbishment projects are fully or partially repetitive. It therefore makes sense for EEF to have standard procedures, model documents and contracts available for these cases. This will make its work easier and furthermore; this approach has the advantage that project handling is more easily standardized. Similar projects are treated in the same way. Key components of the scenario include:

- Grant Component: The 20%/25% Grant component for the clients shall be secured by the future Albania Energy Efficiency Fund (EEF), this component can be financed through various sources, including the Albania State Budget, Albania Municipalities Budget (to cover part of the investment for vulnerable families); EU delegation funding, IPA III funds or other available funding like existing GEEF/EBRD. This financial support reduces the initial financial burden on users. However, it is important to have into consideration the working capital is needed for the operation of EEF since the grant comes after project verification.
- Preferential Loans from local Commercial Banks: This component involves significant loans under favourable terms, further facilitating access to the necessary funds for the realization of energy efficiency projects.
- Technical Assistance (TA) from EEF: By providing TA, EEF assists applicants in processes by standardise all phases, such as: application, monitoring, verification, and the disbursement of a portion of the grant upon project completion. This ensures smooth project realization and proper use of funds. This is similar with actual situation of GEEF/EBRD and it is important that such successful scheme to increase their role together with local banks.

IV.2.1.3.2 MABs

Despite all efforts, the implementation of EE/RES/Green measures level is very low. Based on the deep knowledge of the Community Fund of Tirana Municipality and WB projects, the presented financial structure below provides one possibility to secure the financial resources to be provided by the EEF, Municipalities, Apartment Owners (as members of HOAs) and possible Albanian local banks with the main goal to implement EE/RES/Green measures for different MABs. Energy Audit, Detail Engineering Designs, Procurement and especially the actual financial situation of different owners will give the right data to prepare the Provisional Financial Plan, which will present in more detail the respective contributions and will list how and when all above-mentioned contributors will get involved. EEF will be the main contributor which will assist in securing finance including all preparatory studies and documentation Grant Component: The 20-35% Grant component for the clients shall be secured by the future Albania Energy Efficiency Fund (EEF), this component can be financed through various sources, including the Albania State Budget, Albania Municipalities Budget (to cover part of the investment for vulnerable families); EU delegation.

IV.2.1.4 Direct EE financial models for the residential sector (single houses and MABs)

Those clients who have sufficient funds available will be able to make EE/RES investments in their house or apartment as well as SMEs using their funds. For this reason, the Direct Model is suitable for them, since by excluding the involvement of the banks they will not need to follow all the steps of the

Indirect Model. Following detail analysis will deal more for presenting preliminary concept for financial EE/RES mechanisms for the “direct model” for vulnerable families (being single houses or apartment owners’ parts of MABs) and this scheme is very important having into consideration that relatively moderate number of families classified as vulnerable families. The Direct Model, proposed to be supported by EEF's strategic interventions, will represents a paradigm shift in the financing of EE/RES projects. Through a combination of grant incentives, technical assistance, and awareness initiatives, EEF will catalyse private investment in EE/RES and green projects, thus contributing to the overarching goals of energy conservation, environmental sustainability, and economic resilience. This model proposed for supporting vulnerable families for carrying out EE/RES investment will underscore the synergy between private initiative and public support, setting a benchmark for future EE/RES financing frameworks.

Under this sub-group are included families living on the single houses and MABs and who are not creditworthy and not eligible to receive loans from the local banks, the reasons for not eligible categories could be different some of them are because they do have not enough normal income and they do not have enough collateral to fulfil the request of the banks. The proposed financial model, termed the "Direct Model for Vulnerable Categories," is specifically designed to cater to the needs of the Residential-Individual Houses Sub-Sector, encompassing those not deemed creditworthy and ineligible to receive loans from banks due to poor creditworthiness. This model bypasses traditional banking channels, offering a streamlined pathway to EE/RES investments. EEF cannot provide loans to home owners and EE/RES investments will be 85-100% grant and in some cases a small contribution up to 0-15% might be required by vulnerable families.

IV.3 Central and Municipality Public Building Stock

The typically non-standardized public building EE/RES projects create high preparation and transaction costs which are inappropriate for straight forward commercial financing models. In the following the potentially three relevant financing mechanisms for Albania are presented and analysed:

1. Public ESCO or super ESCO in comparison with Commercial financing using private ESCOs/performance contracts;
2. Budget financing with capital recovery: financing by MOF using government budget allocations or IFI/donor funds, investment grant or budget financing; and
3. EE/RES revolving mechanism (or fund).

IV.3.1 Energy Performance Contracting (EPC)

Energy performance contracting (EPC) is a core **instrument for public and commercial ESCO financing** mechanisms. Under EPC an energy service company (ESCO) finances EE investments and, subsequently, is repaid through the full or partial annual energy savings achieved throughout the contract period. Under an EPC, the revenues obtained from energy savings should be used to refinance obligations.

IV.3.2 Energy Service Agreements (ESA)

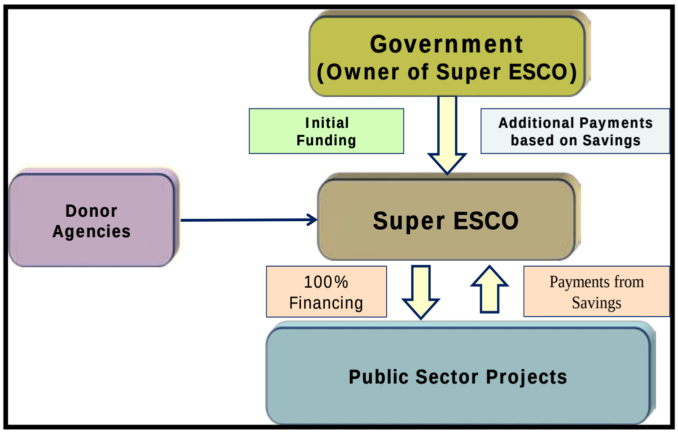
Under an ESA, an **EE Revolving Fund or Mechanism, ESCO** or other EE service provider offers a full package of services to identify, finance, implement and monitor EE projects for clients. The client is usually required to pay all, or a portion of, their baseline energy bill, to cover the investment cost and associated fees until the contract period ends. ESA payments can also be bundled with a client’s energy bills. In this case, the figure on the right illustrates the basic idea of a client’s energy cash flows under the ESA, with payments equal to their baseline energy bill. In some cases, the contract duration is fixed; in other cases, the contract can be terminated after an agreed level of payment has been made, which can encourage the client to save more energy. For municipal clients, ESAs are generally not viewed as municipal debt by MOFs, since they can be viewed as long-term contractual commitments or a form of utility service. If both the client and the mechanism are public, public procurement rules may not be required, making financing simpler. This provides a dual advantage to the client of being relatively simple and of carrying very little risk.

IV.3.3 Public or super ESCO

Several countries have taken a more active role in promoting EE projects **using the performance contracting** approach by creating either public or “super” ESCOs that are wholly or partly owned by the state. Often this was done **to promote private ESCOs** in general, examples include China (pilot EMCs created by the World Bank in Beijing, Shandong, and Liaoning) and Armenia (R2E2). Such public ESCOs were typically formed when the local ESCO markets were nascent and some public effort was deemed necessary to catalyse them. The advantage of a public ESCO is that there is often no competitive process required for project development since a public agency is simply contracting with another public entity. The *super* ESCO will be a special type of public ESCO and it will be established by the government, it functions as an ESCO for the public sector market (hospitals, schools, municipal utilities, government buildings) while also supporting the **capacity development and project development activities of existing private sector ESCOs**. The government (possibly with help from IFIs) will capitalize the super ESCO with sufficient funds to undertake public sector EPC projects and to leverage commercial financing.

A primary function of the super ESCO is to facilitate access to project financing by developing relationships with local or international financial institutions. The super ESCO may also provide credit or risk guarantees for ESCO projects, or act as a leasing or financing company to provide ESCOs and/or customers with EE equipment on lease or on benefit-sharing terms. A super ESCO can be uniquely positioned to overcome a number of the barriers faced by smaller ESCO companies. With its size and credibility as a public institution, a super ESCO has the capacity both to support the growth of a nation's private domestic ESCO business and to finance EE projects. Contracting between public ESCO and public sector clients may be easier than with private sector service providers. Figure IV-1 illustrates the structure of a super ESCO.

Figure IV-1: Typical Structure of a Super ESCO



Source: World Bank Publication by Limaye (2013).

The **applicability of the public or super ESCO mechanism is limited** under the current framework conditions in Albania, because of the gaps of (i) Lack of secondary legislation for Energy Performance Contracting and ESCO business, (ii) Low developed energy services market and ***the market is not mature***. There are no ESCOs in Albania and new secondary legislation will be required to establish the legal basis of ESCO financing mechanisms, hence the option was not explored further.

IV.3.4 Energy savings capture mechanism (ESCM)

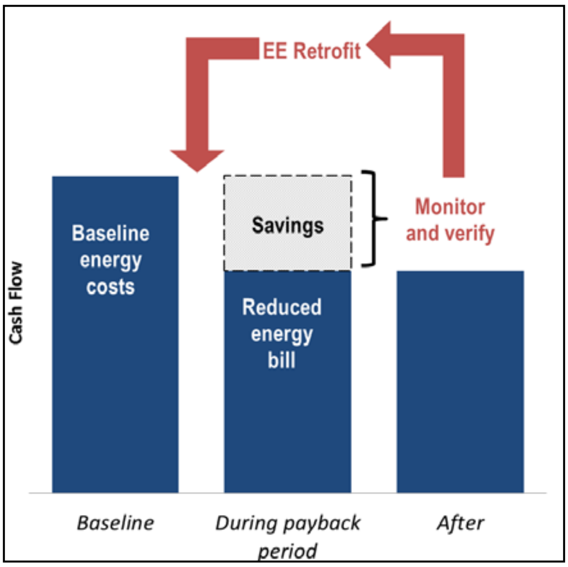
This approach, also referred to as "budget capture," anticipates that financing is provided by a government agency, such as the Ministry of Finance (MOF), using a combination of government budget allocations and funds from donors and international financial institutions (IFIs). This funding covers the investment costs of the EE projects in both central and municipal buildings and facilities. The recipient of the funding "repays" the funds using the savings generated by the investment project in the form of reduced budgetary outlays ("budget capture") for energy bills of the public agency in future years. The size of the reduced outlay is usually based on the amount of energy cost savings. The flow of funds to pay for EE/RES improvements follows the same procedures as for any other funds received from the MOF.

The **Energy Savings Capture Mechanism** anticipates that financing is provided by the MoF, using a combination of government budget allocations (e.g., for planned retrofit of hospitals) and funds from donors and international financial institutions IFIs. The "budget capture" *at Ministry of Finance* will be realized at the level of the line ministry on the monitored and verified saved energy costs. Neither the line ministry nor the central public building (e.g., hospital) will physically repay saved energy costs to the MoF, instead the MoF will reduce the annual support to the line ministry by the calculated energy cost savings.

Conclusion - Disadvantages and risks: The energy savings capture model is fragile on political stability, that the governmental agencies, foremost the MoF maintain the model for a long-term. In addition, there are high administrative burden and by those risks the sustainable EE financing mechanism. Particular identified barriers are the accounting of the 'saved energy expenditure' based on a baseline of costs for energy supply for norm comfort conditions.

The ESCM is not applicable for municipal public buildings, because their energy expenses are funded from Municipal budget. In addition, there will be a complication at the level of MoF to consider the provided grant and donor funds (from international and governmental sources) in the reduction of annual budget support. This bears the risk of not meeting the requirements for target monitoring by donors.

IV.3.5 EE revolving mechanism (EERM)



With the exception of budget financing, other sources of financing for public sector EE investments require mechanisms to ensure the repayments of the invested funds, typically through cash flows generated by reduced energy costs resulting from the implementation of the EE projects. Such repayments require well defined and agreed upon procedures for determining project baselines, assessment and verification of energy and cost savings, and retention of budgetary savings.

An **EE revolving financing mechanism (EERM)** has been proven to be a viable option for scaling up EE financing in the public sector. Typically, EERM are referred to as 'EE Revolving Fund' (EERF), when they are set up as institutionally independent entities. The basic concept of the energy savings revolving mechanism is that these cost savings resulting from EE retrofit investment can be used to support additional EE investments without requiring another capital injection or increasing public debt. As part of the energy savings revolving mechanism, the generated energy cost savings in each retrofitted facility would be monitored, verified and captured in an escrow account to support EE investments in additional public sector buildings. The establishment of an EE Fund is required by draft Energy Performance in Building Law, but required secondary legislation which will be prepared and adopted for the EE/RES mechanism establishment. The application of an EERM will be legally possible without the official set-up to the EEF, thus speeding-up the practical implementation of sustainable EE financing mechanism. A mechanism can be housed in any existing institutional entity which is not necessarily the "fund". This mechanism anticipates that financing is provided by the MoF, using a combination of government budget allocations (e.g., for planned retrofit of hospitals, schools, social facilities, etc.) and funds from donors and international financial institutions (IFIs). This funding covers the investment costs of the EE projects in the buildings.

Under a typical EERM, created using public funds and IFI loans, financing is provided to public agencies to cover the initial investment costs of EE projects. The resulting energy cost savings are then accumulated in an EE ESCROW account and used to repay the to the EERM until the original investment is recovered, plus service charges. The repayments can then be used to finance additional projects, thereby allowing the capital to revolve and creating a sustainable financing mechanism. Since both the borrower and lender are publicly owned, such funds may often offer lower-cost financing with longer repayment periods and less-stringent security requirements than typical commercial loans. Because EE projects have positive financial rates of return, capturing these cost savings and reusing them for new investments creates a more-efficient use of public funds than typical budget- or grant-funded approaches.

The advantages of the EERM financing mechanism for Albania compared to alternative options, such as super ESCO or budget capture, are:

- Lower risks of funds to get lost due to higher transparency of processes, fund flow and revolving

funds through an independent PMU,
- EERM addresses the barrier of insufficient liquidity in banking sector,
- EERM can make use of grant funds from governmental and international sources for blending with IFI loans to offer financing conditional terms,
- EERM can generate a high level of leveraging co-financing from various entities: a) governmental financing, b) donor co-financing and c) IFI financing,
- Through a management by a central PMU the EERM has the potential to:
    - Achieve high quality level of quality of project preparation, energy audits and management,
    - International experiences and expertise utilized to TA,
    - Energy and GHG savings can be centrally monitored, analysed, reported and promoted,
    - Results and experiences can be disseminated widely and efficiently for scaling up,
    - Lower specific costs for equipment and works can be achieved through scaling up effects of projects bundling and combined procurement,
    - Wider application of advanced EE technologies (such as heat pumps and solar applications) due to better outreach and cooperation with suppliers,
    - Standardization of project preparation and implementation procedures and by that lover transaction efforts and costs,
    - Acquire additional grant, donor, equity and debt financing form additional sponsors (e.g., ministries, EBRD, etc.),
    - Mobilize commercial co-financing in the medium to long-term run,
    - Improved coordination and cooperation among governmental agencies,
    - Extension of the financing mechanism to other public building sectors (central administrations, line ministries),
    - Help to develop energy service suppliers and ESCO market in the long-run,
    - Addresses financing needs and evolving capacity of municipalities,
    - Support disseminating of information on EE subproject performance/financial data critical to sustainability.

The EERM's main object of activity is the managing of the financial resources in order to finance the projects in the area of energy efficiency and to undertake project development, procurement, implementation supervision and monitoring. The EERM will realize its scope by providing financing to financially profitable projects that may assure sustainability and energy savings. The EERM could provide direct financing for EE projects, sometimes requiring co-financing from donors or IFI. The EERM is structured to aggressively seek out municipal EE projects; work closely with potential project owners; and perform project preparation, supervision, and collection services.

The EERM can offer financial instruments such as blending of grants and loans for direct EE investment projects as well as for services for capacity building and project preparation and implementation. The key element will direct investment through energy performance contracts (EPCs) with municipal beneficiaries and health sector facilities. The higher-level targets of the EERM are (i) to demonstrate EE Revolving as functioning and profitable model to attract private participation, and (ii) to contribute to the achievements of the set EE targets of the Strategic Development plans and Energy Community commitments of Albania. The EERM shall be set-up as between the ADF (Albanian Development Fund) institutional structure as PMU. The PMU will act as interface between the finances and donors and the project owner (of the building, municipal or MoHS/hospital) with sovereign and transparent decision power on projects and financial flows.

IV.4 SMEs - Private Services and Industrial Enterprises

At the following is presented a short list of alternative EE financial models for SMEs:
- Pay-As-You-Save (PAYGO)
- Performance Contracting
- Green Leases
- Energy Efficiency Certificates (EECs)
- On-Bill Financing
- Green Bonds
- Green Crowdfunding
- Indirect SMEs financial model
- Direct SMEs financial model

IV.4.1 Performance Contracting

Energy Service Companies (ESCOs) guarantee energy savings and share them with SMEs. ESCOs invest in and implement upgrades, recouping their costs through a portion of the achieved savings. This model aligns interests and reduces risk for SMEs. ESCOs take on the financial and performance risks of energy efficiency projects. They invest in and implement the upgrades, which means that SMEs do not have to allocate upfront investment for these improvements. The ESCO guarantees a certain level of energy savings, thereby offering SMEs a predictable benefit. This assurance can make the decision to proceed with energy efficiency upgrades more appealing. SMEs gain access to specialized knowledge and advanced technologies through ESCOs, which may otherwise be out of reach due to cost or complexity. Some of the challenges to be consider are as follows:

- Dependency on Savings***:*** The model's success heavily depends on the actual realization of energy savings. If the projected savings are not achieved, it could affect the financial terms and benefits for both the ESCO and the SME.
- Complex Financial Arrangements***:*** The payment agreements and cost-sharing mechanisms can be complex and may require SMEs to engage in lengthy contractual negotiations.
- Suitability of Technologies***:*** There are challenges in finding appropriate technologies that fit the specific needs of SMEs in Albania, considering the local infrastructure and industry practices.
- Long-Term Commitment***:*** Energy efficiency projects often require long-term commitments, which can be a deterrent for SMEs that prefer or require more flexible arrangements.
- Lack of Specific Legislation***:*** Albania may not have the necessary legal frameworks to support ESCO operations fully, particularly regarding the enforcement of contracts and the protection of both parties' rights.
- Regulatory Uncertainty***:*** Changes in energy policies or economic conditions could impact the agreed terms, potentially making contracts less favourable for SMEs.
- Awareness and Trust Issues***:*** There is a general lack of awareness among SMEs about what ESCOs are and the benefits they can offer. Moreover, trust in third-party operators managing critical aspects of a business is low.
- Adoption Resistance: There will be resistance to outsourcing energy management to a third party, as businesses may prefer to maintain control over their operations.
- Perceived Risk***:*** Local banks in Albania perceive investments in ESCO projects as high-risk, primarily due to uncertainties in achieving projected energy savings. The investment banking programs don't exist.
- Lack of Familiarity***:*** Banks are not familiar with the ESCO model, hindering their willingness to provide financing.
- Insufficient Collateral***:*** ESCO projects often lack tangible assets that could serve as collateral, posing a challenge in traditional lending scenarios which is the case in Albania.
- Long-Term Returns***:*** The extended duration for ROI in ESCO projects does not align with the shorter-term lending preferences of local banks.
- Regulatory Environment***:*** A lack of supportive regulations may deter banks from funding energy efficiency projects.

While the ESCO model offers a promising avenue for energy efficiency improvements in Albania SMEs by minimizing risk and aligning interests through guaranteed savings, there are substantial financial, technical, legal, cultural, and financing challenges to overcome. The reluctance of local banks to finance such projects due to perceived risks and a lack of suitable regulatory frameworks highlights the need for more robust support systems. Clearer legislation, better financial incentives, and educational initiatives to familiarize banks and businesses with the benefits and operational mechanisms of ESCOs would help create a more conducive environment for these projects and foster sustainable economic growth of Albania.

IV.4.2 Indirect EE financial models for the SMEs sector

In Albania, SMEs that are considered creditworthy and eligible to receive loans from banks without external support typically exhibit certain characteristics. These companies often have a strong financial history, demonstrating consistent revenue growth and profitability. They maintain good credit records, showing a history of meeting financial obligations on time. Their business plans are robust and well-defined, indicating a clear path for future growth and sustainability. These SMEs are usually of a size where they have established a solid market presence, with a reasonable share in their respective sectors. They often possess assets that can serve as collateral, further enhancing their creditworthiness. In essence, these companies represent a low risk for banks, making them suitable candidates for credit without the need for additional support mechanisms. These SMEs still face challenges in energy management and efficiency. A critical issue observed in such companies is internal management challenges, often stemming from the company's growth outpacing its initial management capacity. In the context of contemporary financial planning, the customization of financial models to accommodate the distinct requirements of specific projects is crucial for achieving outcomes that are both economically viable and sustainable. This principle is particularly relevant in the development of financial models for SMEs, which play a pivotal role in the economic development of Albania. Our approach is designed to facilitate these businesses' access to funding for energy efficiency (EE) projects, employing both indirect and direct models to cater to their diverse needs.

IV.4.3 SMEs, which are not creditworthiness for receiving directly loans from banks

Albania's SME sector pulsates with potential, yet many lack access to crucial resources, particularly finance. Deemed "non-creditworthy" by local banks due to limited financial history or inadequate collateral, these businesses struggle to secure the capital needed to innovate and grow. This not only hinders their individual potential but also restricts their contribution to the nation's sustainable development. While pinpointing the exact number of non-creditworthy SMEs in Albania is challenging, estimates suggest a significant portion faces similar limitations. With approximative of 93% of all enterprises in Albania being SMEs, as INSTAT Yearly Report 2023, their potential is vast. Yet, without adequate financial support, their contribution to economic growth and sustainability remains constrained. By providing crucial financial access, expert guidance, and ongoing support by different IFIs will continue to empower non-creditworthy SMEs to unlock their potential and contribute to a more sustainable Albania. This collaborative approach will pave the way for a future where innovation, job creation, and environmental responsibility go hand in hand, weaving a brighter tapestry for the nation's economy.

IV.5 Proposed New Strategies and Policy Measures for Boosting EE/RES for Meeting Heating and Cooling Energy Demand

The table IV-4 shows the overview of all policies and measures which shall be executed to ensure the roadmap's decarbonisation targets achieved.

Table IV-4: Overview of policies and measures for the decarbonization of Albania's Heating and Cooling for building stock and industry sectors

Nr.	NECP code	Policies and measures title	Type	Estimated Investment needs [EUR]
1	EE-I3	Implementation of minimum energy performance standards for existing and new buildings	Legislative	325,000 (until 2030)
2	EE-L6	Energy renovation programme for occupied residential buildings	Legislative / Financing / Investment	Soft part 450,000 (until 2030) 17.86 billion* (until 2050)
3	EE-L4, EE-L5 and EE-L7	Energy renovation programme for public (central and municipal) buildings	Legislative / Financing / Investment	Soft part 1.61 billion* (until 2050)
4	EE-L6	Energy renovation programme for private service and commercial buildings	Regulatory; Financial; Information	Soft part 5.75 billion* (until 2050)
5	EM-P1	Eradicate energy poverty	Legislative	50,000 (until 2030)
6	-	Development of financial support schemes for improving energy efficiency / utilizing renewable energy in buildings	Legislative; Financial	500,000 (until 2030)

Nr.	NECP code	Policies and measures title	Type	Estimated Investment needs [EUR]
7	EE-I1	Inspection of Building Technical Systems	Legislative; Technical	200,000 (until 2030)
8	EE-O1	Energy efficiency obligation scheme and alternative measures for Albania	Legislative	20,000 (until 2030)
9	EE-S1	Uptake of ESCO models	Legislative	100,000 (until 2030)
10	EE-P2	Alignment of Municipalities Energy and Climate Action Plans with the BRP	Legislative	30,000-80,000 per municipality (until 2030)
11	R-E3	Energy spatial planning for increasing the share of renewable energy and improve energy efficiency	Legislative	500,000 (until 2030)
12	R-E4	Mechanism of net metering for installations up to 500 kW	Legislative	30,000 (until 2030)
13	R-E9	Supporting the formation of renewable energy communities	Legislative	170,000 (until 2030)
14	R-E11	Municipal Heat Maps	Legislative	500,000 (until 2030)
15	G-B1	Policies to support RES in Heating and Cooling Sector including CHP systems	Legislative	50,000 (until 2030)
16	-	Creation of one-stop shops for the energy performance of buildings	Awareness	1,000,000 (until 2030)
17	-	Deployment of solar energy installations on buildings	Legislative	50,000 (until 2030)
18	-	Promotion of district heating, CHP schemes (and triple generation: heating, cooling and power) and neighbourhood approaches and integrated renovation programmes at district level, addressing issues such as energy, mobility, green infrastructure, waste and water treatment and other aspects of urban planning	Legislative / Awareness	100,000 (until 2030)
19	EE-P1	Exemplary role of public sector	Legislative	50,000 (until 2030)
20	-	Addressing skills gaps and promoting education, targeted training, upskilling and reskilling in the construction sector and energy efficiency and renewable energy sectors	Awareness	300,000 (2026-2027)
21	-	Awareness-raising campaign	Awareness	300,000 (until 2030)

Source: Calculation carried out by the EECG consulting team

* *Note: the investment needs do not mean the allocation of sources of funding from the state budget. The renovation implementation programme(s) for the different periods (for example 2026 - 2030), should allocate the sources of financing for different residential building types. Source: LTBRAP*

Each of the above stated policies and measures are in more details elaborated in the tables below. Among other details, the descriptions contain budget estimates that are intended to provide orientation for the detailed planning of the individual PaMs. The up-front transaction costs/enabling environment soft investments, are also determined, i.e., implementation programmes, technical studies, promotional activities, technical assistance, trainings, development of guidelines/instructions, etc., which are necessary to make an investment successful in terms of achieving the objectives of a policy and measure. It shall be clear that the actual sums depend on the level of detail and the experts involved (national/international), and also on existing resources that could be utilized. The description of policies and measures also contains a section on the implementing entity.

IV.5.1 Implementation of minimum energy performance standards for existing and new buildings

Following box presents main aspects for the Implementation of minimum energy performance standards for existing and new buildings.

Title of measure	**Implementation of minimum energy performance standards for existing and new buildings**
BRP reference	1
NECP reference	EE-I3
Type of	Legislative
Date of entry	2026
Timeframe / implementation	2026 and ongoing
Legal basis and planning documents	Law on EPB Energy Performance of Buildings Directive (EU/2024/1275)

Actions taken to date / status of implementation	• *Law on EPB developed, enabling the implementation of Minimum Energy Performance Requirements for buildings*
	• *BRP identified annual plans to follow the building renovation trajectory until 2050*
	• *BRP identified the number or floor area of the 43 % worst-performing residential buildings and residential building units*
	• *Adopted the relevant legislation for Implementation of the Minimum Energy Performance Requirements in buildings and issuing the Energy Performance Certificate (EPC)*
	  o *DCM No. 537 of 8.7.2020 "On approval of minimum energy performance requirements for the buildings and the building elements";*
	  o *DCM No. 958, of 2.12.2020 "On the approval of certification procedures and conditions energy performance of buildings and models, content of the conditions of registration of the "certificate of building energy performance";*
	  o *"National Methodology for Calculating Energy Performance in Buildings" approved by DCM no. 1094, dated 24/12/2020;*
	  o *Decision no. 256, dated 27/3/2020 "On the Approval of the Methodology for Calculating the Optimal Cost Levels for the Minimum Energy Performance Requirements of Buildings, Units and Elements of Buildings";*
	  o *Decision no. 934, dated 25/11/2020 on "Approval of Criteria and Procedures for the Manner of Selection and Quantity of Certificates to be Verified, as well as the Process of Supervision of Energy Performance Certificates in Buildings";*

Main Objective / quantified objective	To ensure the decarbonisation of the national building stock is in line with the climate neutrality by 2050 objective.

Results to be achieved / expected impact	Minimum energy performance standards should ensure that Deep renovation and ZEB standards are achieved while retrofitting existing buildings and constructing new buildings.
	
	Residential building stock results to be achieved:
	• retrofitting 75% of worst-performing residential buildings according to ZEB concept, while 25% of worst-performing residential buildings will be retrofitted according to the Deep renovation concept.
	• retrofitting 75% of all other residential buildings (not WPB) according to ZEB concept, while 25% will be retrofitted according to the Deep renovation concept.
	• all new residential buildings which will be constructed from January 1st 2030, are ZEB.
	• Minimum energy performance standards for residential buildings ensure, at least, that all residential buildings are decarbonized as follows:
	  o 16% by 2030
	  o 34% by 2035
	  o 60% by 2040
	  o 79% by 2045
	  o 100% by 2050

<table>
<tr><td></td><td>Public building stock results to be achieved:
• All existing Central and Municipal Public Buildings will be retrofitted according to DEEP and ZEB concept.
• All new Central and Municipal Public Buildings which will be constructed from January 1st 2030, are ZEB.
• Minimum energy performance standards for Central and Municipal Public Buildings ensure, at least, that all public buildings are decarbonized as follows:
o 25% by 2030
o 49% by 2035
o 76% by 2040
o 96% by 2045
o 100% by 2050
Private Service and Commercial building stock results to be achieved:
• All existing Private Service and Commercial Buildings will be retrofitted according to DEEP and ZEB concept.
• All new Private Service and Commercial Buildings which will be constructed from January 1st 2030, are ZEB.
• Minimum energy performance standards for Private Service and Commercial Buildings ensure, at least, that all buildings are decarbonized as follows:
o 25% by 2030
o 44% by 2035
o 62% by 2040
o 81% by 2045
o 100% by 2050</td></tr>
<tr><td>Measures to be implemented / short description</td><td>Activities:
• Decision of the Council of Ministers sets out the minimum requirements for:
o the energy performance of new buildings and new building units, as well as existing buildings and existing building units that will undergo significant renovation;
o building elements that form part of the building envelope and that have a significant impact on the energy performance of the building envelope when they are renovated or replaced;
o technical systems of buildings, when they are installed, replaced or upgraded;
o the conditions of the interior of the buildings, to guarantee the conditions of comfort and well-being for the users.
• Minimum energy performance requirements shall be reviewed at least every five years and, if necessary, updated in order to reflect technical progress in the construction sector, the results of the optimal cost calculation, and the objectives and updated NECP and BRP.
• Utilize Energy Performance Certificates to monitor the implementation of minimum energy performance standards, by cross-checking at least the numerical indicator of the specific primary energy kWh/m²a.
• For existing buildings, the energy performance certificate shall include recommendations for the cost-effective improvement of the energy performance and the improvement of indoor environmental quality of a building or building unit, unless the building or building unit already achieves at least energy performance class A. This shall be the responsibility of energy auditors.
• The energy performance certificate shall provide an indication as to where the owner or tenant of the building or building unit can receive more detailed information in regards to the cost-effectiveness of the recommendations made in the energy performance certificate.
• The EEA should ensure that the temporary (pre-renovation) and 10-year energy performance certificate (post-renovation) are developed and issued for all major renovations.
• The EEA should develop an independent control system for EPCs in accordance with EPBD.
• The Government should ensure that the energy performance certificate is part of the documents necessary for the realization of the sales or lease contract. Building units that are offered for sale or rent must as well be provided with the energy performance certificate, and the energy performance indicator and energy performance certificate class of the building or building unit, and shall be stated in on-line and off-line advertisements, including property search portal websites. Moreover, an</td></tr>
</table>

	obligatory deadline by which all buildings should poses an EPC should be introduced/defined; including a transition period for two years for public sector buildings, five years for private/commercial. • The MoIE should **ensure training programmes for energy auditors** which will be responsible for the development and issuing of energy performance certificates. This shall include i) capacity building for the competent authority and energy auditors on implementation of the legislation and using the software for issuing the EPC, ii) basic training courses for residential and non-residential buildings including examinations are offered, and iii) renewal training courses for residential and non-residential buildings including examinations are offered. • The MoIE and EEA should **develop a centralized database on energy performance of buildings and energy performance certificates and track and monitor regularly the implementation of minimum energy performance standards.** The centralised database should meet the requirements of EPBD 2024/1275 Article 22.
Investment needs and funding sources	Estimated investment needs until 2030: Development of an EPC database incl. independent control system (already under development): approx. 200,000 EUR Maintenance of EPC database and software (until 2030): approx. 125,000 EUR (25,000 EUR per year)
Implementing Entity	Government of Albania, MoIE, Energy Efficiency Agency, Inspection, construction/usage permit issuing authorities, energy auditors.

IV.5.2 Energy renovation programme for occupied residential buildings

Following box presents main aspects for the energy renovation programme for occupied residential buildings.

Title of measure BRP reference NECP	**Energy renovation programme for occupied residential buildings** 2 EE-L6
Type of Instrument	Legislative / Financing / Investment
Date of entry into force	2026
Timeframe / implementation period	2026 – ongoing
Legal basis and planning documents	Law on EPBD *Energy Performance of Buildings Directive (EU/2024/1275) (recast)*
Actions taken to date / status of implementation	National Building Renovation Plan as a basis for future renovation programmes for targeted periods until 2050.
Main Objective / quantified objective	The main objective of the measure is the improvement of the energy performance and the reduction of greenhouse gas emissions from residential buildings in Albania, aiming to achieve a zero-emission building stock by 2050 in accordance with the National Building Renovation Plan – roadmap 2030, 2040 and 2050. It is envisaged to retrofit all worst performing residential buildings (WPB) until 2040. The targets to achieve a decarbonized building sector are as follows: • share of decarbonized residential building stock by 2030 – 16%, • share of decarbonized residential building stock by 2035 – 34%, • share of decarbonized residential building stock by 2040 – 60%, • share of decarbonized residential building stock by 2045 – 79%, and • share of decarbonized residential building stock by 2050 – 100%.
Results to be achieved / expected impact	The expected cumulative total area (m^2) of **residential buildings** to be retrofitted: • by 2030 – 10.387.000 m^2 (of which 10.387.000 m^2 WPB will be retrofitted) • by 2035 – 22.439.000 m^2 (of which 17.264.000 m^2 WPB will be retrofitted) • by 2040 – 43.607.000 m^2 (of which 24.458.000 m^2 WPB will be retrofitted) • by 2045 – 65.360.000 m^2 • by 2050 – 94.924.000 m^2 The expected cumulative total **number of dwellings** to be retrofitted:

	• by 2030 – 130.055 dwellings • by 2035 – 275.016 dwellings • by 2040 – 519.739 dwellings • by 2045 – 762.235 dwellings • by 2050 – 1.079.000 dwellings The expected cumulative primarily energy savings (ktoe): • by 2030 – 119 ktoe • by 2035 – 231 ktoe • by 2040 – 380 ktoe • by 2045 – 507 ktoe • by 2050 – 654 ktoe The expected cumulative CO_2 emission reduction (kt): • by 2030 – 261 kt • by 2035 – 509 kt • by 2040 – 847 kt • by 2045 – 1.137 kt • by 2050 – 1.477 kt
Measures to be implemented / short description	The Programme should be envisaged as a launch of Albania's energy renovation programme for residential buildings, for which purposes the BRP shall be used to set and report against defined renovation targets and objectives (number and m² to be retrofitted of a specific residential building type within a specific period). The first renovation programme should aim to be implemented in the period 2027 – 2030. The responsible government institutions should plan and allocate sufficient co-financing and shall define the co-financing criteria, eligibility, implementation procedures and priorities (WPB and energy poverty for example). Deep and ZEB building renovation should be the minimum standard (and in line with the existing minimum energy performance standards legal acts of Albania) to be achieved while retrofitting existing buildings, thus enabling a full decarbonisation of the occupied residential building stock by 2050, by: • retrofitting 75% of worst-performing residential buildings according to ZEB concept, while 25% of worst-performing residential buildings will be retrofitted according to the Deep renovation concept. • retrofitting 75% of all other residential buildings (not WPB) according to ZEB concept, while 25% will be retrofitted according to the Deep renovation concept. The Deep renovation EE/RES scenario foresees following package of measures (considering the EE first principle): • Thermal insulation of exterior walls • Thermal insulation of the roof • Thermal insulation of the floor • Installation of efficient windows • Installation of efficient external doors • Efficient heat pump system (or central heating systems based on biomass) • Installation of energy-efficient LED bulbs. The ZEB renovation scenario foresees following package of measures, in addition to the Deep renovation measures: • Solar Hot Water System • Installation of a Photovoltaic System Activities: • Development of the renovation programme targeting the 2027 – 2030 period, followed up by renovation programme 2031 – 2040 and 2041 – 2050, by the MoIE and EEA; i.e., the MoIE, in cooperation with other relevant government institutions, will prepare the Energy renovation programme's implementation plan for the renovation of residential buildings for 2027 – 2030, which shall be adopted by the Albanian Government. The BRP and the Programme for 2027 – 2030 shall serve as the basis for the use of funds and the development of financial mechanisms to support the Programme; moreover, the implementation process, role and responsibilities, etc. shall be defined in the Programme. • Focus and target first WPB is to ensure their gradual phasing-out. • The Government should ensure promotional activities and technical assistance for energy audits, support from one stop shops on technical suggestions or energy managers from the city/municipality to support applicants and renovation activities. • The MoIE and EEA should ensure a monitoring system is in place to track the effects and results of renovation activities of the residential sector.

Investment needs and funding sources	The estimated investment needs for the 2024– 2050 period for decarbonizing Albania's residential building stock are projected to EUR 17,86 billion. The exact amounts of investment needs and required grants for co-financing should be defined in Energy renovation programme for occupied residential buildings for each renovation period (market maturity and increased energy prices should contribute to a lower grant co-financing amount needed for residential buildings from 2035/2040 onwards). Renovation programs should be supported with a multi-annual budget to ensure continuous implementation of projects and avoid a "stop-and-go" approach. This consistent support will stimulate the development of a market for energy-efficient renovations and build capacity among installers. Total investment needs*: • by 2030 – EUR 2.765 billion • by 2035 – EUR 4.545 billion • by 2040 – EUR 8.456 billion • by 2045 – EUR 11.245 billion • by 2050 – EUR 17.863 billion Development of Energy renovation programme 2027-2030: approx. 150,000 EUR Promotional activities: approx. 300,000 EUR Technical assistance 2027-2030: covered by OSS; in case the OSS are not developed and operational, TA costs should be allocated to support the execution of the Renovation Programme. Possible funding sources: • co-financing by homeowners. • co-financing by the Albanian Government via financial mechanisms (targeted granting, soft-loans, tax reduction/exemption for EE/RE products and equipment, public ESCO model, etc.). • co-financing by the Albanian Government of up to 100% of EE/RE investments for energy retrofits for socially vulnerable groups living in energy poverty. • co-financing via international, EU and other development funds. *<u>Note</u>: *the investment needs do not mean the allocation of sources of funding from the state budget. The renovation implementation programme for the different periods (for example 2027 - 2030), should allocate the sources of financing for different residential building types.* *For new buildings only EE/RES measures for meeting ZEB's conditions are included.*
Implementing Entity	MoIE, Energy Efficiency Agency, National Energy Efficiency Fund (EE Fund) * MoIE – development of the Programme, laying down of criteria, operational monitoring of Programme implementation; EEA and EE Fund – overall implementation of the Programme **Note: The National EE Fund will be established according to the prepared draft EE Law*

IV.5.3 Eradicate energy poverty

Following box presents the eradicate energy poverty measures.

Title of measure BRP reference NECP	**Eradicate energy poverty** 5 EM-P1
Type of Instrument	Regulatory
Date of entry into force	2021 - 2040
Timeframe / implementation period	2022 – ongoing
Legal basis and planning documents	Law on the electric energy sector Law on energy performance of buildings Law on energy efficiency EED EPBD
Actions taken to date / status of implementation	• BRP developed and adopted with baseline indicators and targets for reduction of energy poverty • Creation of legal framework • NECP adopted • A compensation scheme for electricity consumers is in place since 2006 in the form of cash benefit of 640 ALL (EUR 5,2) for those recognised as consumers in need who reach a monthly threshold of 200 kWh (in force).

	• In 2015 it is approved an additional subsidized cash benefit of 648 ALL (EUR 5,23) per month to protect temporarily vulnerable households which consume up to 300 kWh per month. • ERE Decision No. 246, date 11.12.2018 on approving "Regulation on specific conditions for termination of supply with electricity for the customers in need". Based on this regulation, the Distribution System Operator and Universal Service Provider create and maintain a register with the data of the clients in need.
Main Objective / quantified objective	The objective is to adapt a definition of energy poverty, to establish a national system for systematically monitoring energy poverty reduction and to implement measures to eradicate energy poverty by 2040.
Results to be achieved / expected impact	Eliminating the number of people affected by energy poverty in Albania from 19% (people at risk of poverty in 2023*) by 2040. *Note: Currently, a system to measure and monitor EPBD energy poverty mandatory indicators on a systematic and continuous level does not exist. Therefore, an alternative indicator (until national statistics provide data) has been used – people at risk of poverty.
Measures to be implemented / short description	People facing or risking energy poverty, vulnerable customers, including final users, low- and medium-income households, and people living in social housing should benefit from the application of the energy efficiency first principle. Energy efficiency measures should be implemented as a priority to improve the situations of those individuals and households and to alleviate energy poverty, and should not encourage any disproportionate increase in housing, mobility or energy costs. Activities: • Adopt decision on national definition of energy poverty (national definitions, indicators and criteria of energy poverty, energy poor and vulnerable customers) for Albania according to the definitions provided in the EED and EPBD directives. • Establish a national system for systematically planning and monitoring and implementing measures for eradicating energy poverty, i.e., establish a monitoring and reporting system on energy poverty and develop or improve of relevant indicators and data sets, pertinent to the issue of energy poverty, that should be used and reported upon. • Setting national targets for reduction of energy poverty (targets for 2030, 2035, 2040). • Update any outstanding legal framework on the compensation scheme based on the requirements of the Law on the electric energy sector. • Ensuring appropriate financial measures targeting vulnerable households, people affected by energy poverty or, where applicable, living in social housing – for example grant funding, public co-financing, on-bill financing, etc.; Further, ensure while developing the Renovation programme(s) that financial incentives target, as a priority, vulnerable households, people affected by energy poverty and people living in social housing, and target first energy poverty households living in WPB and support them with co-financing grant schemes for building renovations. • Target first energy poverty households living in WPB and support them with co-financing grant schemes for building renovations. • Track the effects of support towards energy poverty by ensuring regularly monitoring of i) % of people affected by energy poverty, ii) proportion of disposable household income spent on energy, and, if possible iii) population living in inadequate dwelling conditions (e.g., leaking roof) or with inadequate thermal comfort conditions. • Conduct information and training campaigns on energy efficiency improvements within local and regional government units focusing on providing support vulnerable households and households living in energy poverty. Enable OSS to provide advice on energy efficiency improvements related to elimination of energy poverty.
Investment needs and funding sources	Estimated budget (until 2030): 50,000 EUR (TA and advice) Funding source: State Budget, IFIs Technical Assistance Program
Implementing Entity	Ministry of Infrastructure and Energy; Ministry of Health and Social Protection, Ministry of Finance, local government units, The Albania Institute of Statistics, EE Agency

IV.5.4 Energy renovation programme for public (central and municipal) buildings

Following box presents main aspects for the energy renovation programme for public (central and municipal) buildings.

Title of measure BRP reference: NECP reference: EE-L5)	**Energy renovation programme for public (central and municipal) buildings** 3 EE-L4, EE-L5 and EE-L7
Type of Instrument	Legislative / Financing / Investment
Date of entry into force	2026
Timeframe / implementation period	2026 – ongoing
Legal basis and planning documents	Law on EPBD *Energy Performance of Buildings Directive (EU/2024/1275) (recast)*
Actions taken to date / status of implementation	National Building Renovation Plan as a basis for future renovation programmes for targeted periods until 2050.
Main Objective / quantified objective	The main objective of the measure is the improvement of the energy performance and the reduction of greenhouse gas emissions from public buildings in Albania, aiming to achieve a zero-emission building stock by 2050 in accordance with the National Building Renovation Plan – roadmap 2030, 2040 and 2050. The targets to achieve a decarbonized public sector are as follows: • share of decarbonized public building stock by 2030 – 25%, • share of decarbonized public building stock by 2035 – 49%, • share of decarbonized public building stock by 2040 – 76%, • share of decarbonized public building stock by 2045 – 96%, and • share of decarbonized public building stock by 2050 – 100%.
Results to be achieved / expected impact	The expected cumulative **total area (m^2) of public buildings** to be retrofitted: • by 2030 – 1.639.700 m^2 • by 2035 – 3.236.400 m^2 • by 2040 – 5.262.600 m^2 • by 2045 – 7.442.100 m^2 • by 2050 – 9.967.821 m^2 The expected cumulative **total number of public buildings** to be retrofitted: • by 2030 – 2.432 buildings • by 2035 – 4.793 buildings • by 2040 – 7.763 buildings • by 2045 – 10.880 buildings • by 2050 – 13.684 buildings The expected cumulative primarily energy savings (ktoe): • by 2030 – 13 ktoe • by 2035 – 25 ktoe • by 2040 – 41 ktoe • by 2045 – 58 ktoe • by 2050 – 75 ktoe The expected cumulative CO_2 emission reduction (kt): • by 2030 – 17 kt • by 2035 – 33 kt • by 2040 – 52 kt • by 2045 – 74 kt • by 2050 – 95 kt

<table>
<tr><td></td><td>Albania's BRP contains sub-targets for each of the five identified public building types (reference buildings), for each climate zone.</td></tr>
<tr><td>Measures to be implemented / short description</td><td>The Programme should be envisaged as a launch of Albania's energy renovation programme for public buildings, for which purposes the BRP shall be used to set and report against defined renovation targets and objectives (number and m^2 to be retrofitted of a specific public building type within a specific period).
The first renovation programme should aim to be implemented in the period 2026 – 2030. The responsible government institutions should plan and allocate sufficient financing and shall define the financing criteria, eligibility, implementation procedures and priorities. Deep and ZEB building renovation should be the minimum standard (and in line with the existing minimum energy performance standards legal acts of Albania) to be achieved while retrofitting existing public buildings, thus enabling a full decarbonisation by 2050, by:
retrofitting all existing Central and Municipal Public Buildings will be retrofitted according to DEEP and ZEB concept.
The Deep renovation EE/RES scenario foresees following package of measures (considering the EE first principle):
Thermal insulation of exterior walls
Thermal insulation of the roof
Thermal insulation of the floor
Installation of efficient windows
Installation of efficient external doors
Efficient heat pump system (or central heating systems based on biomass)
Installation of energy-efficient LED bulbs.
The ZEB renovation scenario foresees following package of measures, in addition to the Deep renovation measures:
Solar Hot Water System
Installation of a Photovoltaic System
Activities:
Development of the renovation programme targeting the 2026 – 2030 period, followed up by renovation programme 2031 – 2040 and 2041 – 2050, by the MoIE, EEA and all responsible authorities/ministries/local level governments which have the obligation for payment of energy costs of public buildings; i.e. the MoIE, in cooperation with other relevant government institutions, will prepare the Energy renovation programme's implementation plan for the renovation of public buildings for 2026 – 2030, which shall be adopted by the Albanian Government. The BRP and the Programme for 2026 – 2030 shall serve as the basis for the use of funds and the development of financial mechanisms to support the Programme; moreover, the implementation process, role and responsibilities, etc. shall be defined in the Programme. Moreover, in parallel, activities on the development of an Inventory of the public buildings stock and the execution of energy audits/prefeasibility studies for public buildings should be executed (aiming to support the execution Renovation programme for public building).
Focus on WPB public buildings first.
Ensure sufficient financing to support the renovation programme for public buildings (targeting all or a specific number of public buildings types) by the Government.
The Government should ensure promotional activities and technical assistance for energy audits and project documentation (design) development.
The MoIE and EEA should ensure a monitoring system is in place to track the effects and results of renovation activities of the public sector.</td></tr>
<tr><td>Investment needs and funding sources</td><td>The estimated investment needs for the 2024– 2050 period for decarbonizing Albania's public building stock are projected to EUR 1,61 billion. The exact amounts of investment needs should be defined in Energy renovation programme for public buildings for each renovation period.
Total investment needs:
by 2030 – EUR 0.28 billion
by 2035 – EUR 0.55 billion
by 2040 – EUR 0.89 billion
by 2045 – EUR 1.26 billion
by 2050 – EUR 1.61 billion</td></tr>
</table>

	Development of Energy renovation programme 2026-2030: approx. 150,000 EUR (financial mechanisms are not included in this cost allocation; nor the establishment of the EE Fund) Promotional activities: approx. 100,000 EUR Technical assistance 2026-2030: 0.56 million Euro/year or 2.8 million Euro for the whole period 2026-2030 covered by measure EA and feasibility studies. Possible funding sources: • budget allocation, • IFIs' loans, • grant co-financing via international, EU and other development funds/projects (for schools and hospitals WBIF funding is possible).
Implementing Entity	MoIE, Energy Efficiency Agency, Energy Efficiency Fund, relevant ministries and local level governments (municipalities). MoIE – development of the Programme, laying down of criteria, operational monitoring of Programme implementation; EEA and EE Fund – overall implementation of the Programme.

IV.5.5 Energy renovation programme for SMEs - Private Services and Industrial Enterprises

Following box presents main aspects for the Energy renovation programme for SMEs - Private Services and Industrial Enterprises.

Title of measure BRP reference: NECP reference:	**Energy renovation programme for SMEs - Private Services and Industrial Enterprises** **4** EE-L6
Type of Instrument	Legislative / Financing / Investment
Date of entry into force	2026
Timeframe / implementation period	2026 – ongoing
Legal basis and planning documents	Law on EPB *Energy Performance of Buildings Directive (EU/2024/1275)*
Actions taken to date / status of implementation	National Building Renovation Plan as a basis for future renovation programmes for targeted periods until 2050.
Main Objective / quantified objective	The main objective of the measure is the improvement of the energy performance and the reduction of greenhouse gas emissions from SMEs in Albania, aiming to achieve a zero-emission building stock by 2050 in accordance with the National Building Renovation Plan – roadmap 2030, 2040 and 2050. The targets to achieve a decarbonized building sector are as follows: • share of decarbonized private service and commercial building stock by 2030 – 25%, • share of decarbonized private service and commercial building stock by 2035 – 44%, • share of decarbonized private service and commercial building stock by 2040 – 62%, • share of decarbonized private service and commercial building stock by 2045 – 81%, and • share of decarbonized private service and commercial building stock by 2050 – 100%.
Results to be achieved / expected impact	The expected cumulative **total area (m^2) of** SMEs to be retrofitted: • by 2030 – 5.824.000 m^2 • by 2035 – 11.449.000 m^2 • by 2040 – 18.295.157 m^2 • by 2045 – 26.361.667 m^2 • by 2050 – 35.648.894 m^2 The expected cumulative **total number of** SMEs to be retrofitted: • by 2030 – 22.453 SMEs • by 2035 – 42.622 SMEs • by 2040 – 65.792 SMEs • by 2045 – 91.714 SMEs • by 2050 – 120.112 SMEs The expected cumulative primarily energy savings (ktoe):

	• by 2030 – 39 ktoe • by 2035 – 76 ktoe • by 2040 – 120 ktoe • by 2045 – 173 ktoe • by 2050 – 234 ktoe The expected cumulative CO_2 emission reduction (kt): • by 2030 – 107 kt • by 2035 – 208 kt • by 2040 – 330 kt • by 2045 – 473 kt • by 2050 – 639 kt
Measures to be implemented / short description	The Programme should be envisaged as a launch of Albania's energy renovation programme for SMEs shall be used to set and report against defined renovation targets and objectives. The first renovation programme should aim to be implemented in the period 2026 – 2030. The responsible government institutions should plan and allocate co-financing and shall define the co-financing criteria, eligibility, implementation procedures and priorities. Deep and ZEB building renovation should be the minimum standard (and in line with the existing minimum energy performance standards legal acts of Albania) to be achieved while retrofitting existing buildings, thus enabling a full decarbonisation of the private service and commercial building stock by 2050, by: • retrofitting all existing Private Service and Commercial Buildings to DEEP&ZEB, • constructing all new Private Service and Commercial Buildings to be ZEBs from 2030. The Deep renovation EE/RES scenario foresees following package of measures (considering the EE first principle): • Thermal insulation of exterior walls • Thermal insulation of the roof • Thermal insulation of the floor • Installation of efficient windows • Installation of efficient external doors • Efficient heat pump system (or central heating systems based on biomass) • Installation of energy-efficient LED bulbs. The ZEB renovation scenario foresees following package of measures, in addition to the Deep renovation measures: • Solar Hot Water System • Installation of a Photovoltaic System The Programme implementation must be accompanied by intensive promotional activities and technical assistance provided to owners, while ensuring that energy consumption is monitored before and after the energy renovation, with the prerequisites for such monitoring to be created as part of an energy consumption/management or reporting system. Activities: • Development of the renovation programme targeting the 2026 – 2030 period, followed up by renovation programme 2031 – 2040 and 2041 – 2050, by the MoIE and EEA, and ant other relevant authority; i.e., the MoIE, in cooperation with other relevant government institutions, will prepare the Energy renovation programme's implementation plan for the renovation of private service and commercial buildings for 2026 – 2030, which shall be adopted by the Albanian Government. The BRP and the Programme for 2026 – 2030 shall serve as the basis for the use of funds and the development of financial mechanisms to support the Programme; moreover, the implementation process, role and responsibilities, etc. shall be defined in the Programme. • The Government should ensure promotional activities and technical assistance for energy audits, support from one stop shops on technical suggestions to support applicants and renovation activities. • The MoIE and EEA should ensure a monitoring system is in place to track the effects and results of renovation activities of the private service and commercial sector.
Investment needs and funding sources	The estimated investment needs for the 2024– 2050 period for decarbonizing Albania's private service and commercial building stock are projected to EUR 5,750 billion. The exact amounts of investment needs should be defined in Energy renovation programme for private service and commercial buildings for each renovation period.

	Total investment needs*: • by 2030 – EUR 1.324 billion • by 2035 – EUR 2.452 billion • by 2040 – EUR 3.567 billion • by 2045 – EUR 4.622 billion • by 2050 – EUR 5.750 billion Development of Energy renovation programme 2026-2030: approx. 100,000 EUR Promotional activities: approx. 100,000 EUR Technical assistance 2026-2030: covered by OSS see policy measure 16 Possible funding sources: • co-financing by owners. • co-financing by the Albanian Government via financial mechanisms (targeted granting, soft-loans, tax reduction/exemption for EE/RE products and equipment, etc.).
Implementing Entity	MoIE, Energy Efficiency Agency, Energy Efficiency Fund MoIE – development of the Programme, laying down of criteria, operational monitoring of Programme implementation; EEA and EE Fund – overall implementation of the Programme

*<u>*Note</u>: the investment needs do not mean the allocation of sources of funding from the state budget. The renovation implementation programme for the different periods (for example 2026 - 2030), should allocate the sources of financing for different residential building types. For new buildings only EE/RES measures for meeting ZEB's conditions are included.*

IV.5.6 Development of financial support schemes for improving energy efficiency / utilizing renewable energy in buildings

Following box presents main aspects for the development of financial support schemes for improving energy efficiency / utilizing renewable energy in buildings.

Title of measure BRP reference NECP	**Development of financial support schemes for improving energy efficiency / utilizing renewable energy in buildings** 6 (Not included in NECP)
Type of Instrument	Regulatory
Date of entry into force	2022
Timeframe / implementation period	2022 – ongoing
Legal basis and planning documents	Law on Energy Performance in Buildings Law on Energy Efficiency EPB EED Guideline of Minister of Infrastructure and Energy No 22 of 27.10.2022 "On defining the rules, procedures and methodology for family customers benefiting from financing measures for energy saving from solar panels".
Actions taken to date / status of implementation	• There is a legal framework (draft amendment of the EE law) referring to ESCOs that has started to be completed by secondary legislation. • Energy performance contract prepared according to targets. • Support scheme based on the approved Guideline of the Minister of Infrastructure and Energy No 22 of 27.10.2022: 2,000 family customers have received subsidies from the government to cover up to 70% of the cost for the installation of solar panels that will supply their buildings with hot sanitary water.
Main Objective / quantified objective	Ensure the required legal environment for various financial mechanisms and EE/RES investments to be enabled, aiming to contribute to building sector decarbonization goals of Albania.
Results to be achieved /	• Financial support schemes in place for improvement of the energy efficiency in buildings in Albania. • Co-financing the renovation of the residential and commercial/private services building stock.

expected impact	• Co-financing of up to 100% of EE/RE investments for vulnerable groups living in energy poverty. • Investment support for the renovation of worst performing residential buildings. • Ensure a revolving fund/mechanism for public sector buildings is in place. • Utilization of different financial mechanisms within the execution of renovation programmes.
Measures to be implemented / short description	Prior to the execution of a renovation programmes, it is suggested that the Government of Albania and its authorities responsible for the development and execution of the BRP, in cooperation with the Ministry of Finance, IFIs and bilateral and multilateral donor organization, and any other relevant stakeholders, develop targeted group suitable financial mechanisms/models which will support the renovation efforts. Each building's sector should have financial mechanisms which are suitable for the specific target group of stakeholders (single-family housing, MBAs, public buildings – central and municipal, commercial, etc.); however, special attention and focus should be given to energy poverty and vulnerable groups as well as WPB (underheated public buildings as well as 43% worst performing residential buildings). As seed funding and as a market signal ensuring a constant allocation of funding to renovation programme(s), the Government of Albania should allocate a yearly budget for renovations aiming to support the uptake and launch of renovation programmes. While developing financial support schemes for improving energy efficiency / utilizing renewable energy in buildings, take into account following: • Fiscal/taxes deductions, VAT reduction; carbon tax and creation a fund dedicated for financing EE investments and promoting EE investments • Those public subsidies constitute only a partial response to the needs of project developers, which range from technical assistance to the financial structuring of the project. (TA) • State budget: The State allocates to the local government a yearly budget amount to fulfil their objectives. Except that local government by collecting a different kind of taxes define the objectives and targets and deliver/invest a part of their total budget for energy efficiency investments to the building renovation. • Application of energy efficiency obligation schemes • Private investments through ESCOs • Cooperation with IFIs to ensure loans, soft loans and grants, and TA. • Cooperation with commercial FIs to ensure loans and grants. • Cooperation with bilateral and multilateral development/donor agencies to ensure TA and grants. Activities: • Establishment of a dedicated National EE Fund. • The Government should ensure appropriate financial measures, especially those targeting vulnerable households, people affected by energy poverty or, where applicable, living in social housing. This includes the design of integrated financing schemes which provide incentives for in-depth renovations and phased renovations. The financial measures shall describe best practices to encourage lenders to identify and act upon the worst-performing buildings within their portfolios. • Ensure sufficient co-financing to support the renovation programme for residential buildings (targeting all or a specific number of residential buildings and residential building types) by the Government. Develop targeted group specific (individual family houses, MBAs, vulnerable groups) suitable financial mechanisms to support the implementation of the Programme, such as: targeted grant co-financing, soft loans, etc. When providing financial incentives to owners of buildings or building units for the renovation of rented buildings or building units, the Government shall aim at financial incentives benefiting both the owners and the tenants. For vulnerable households incentivise financial schemes that tackle the upfront costs of renovations could be used, such as on-bill schemes, pay-as-you-save schemes or energy performance contracting. • Ensure sufficient financing to support the renovation programme for public buildings (targeting all or a specific number of residential buildings and residential building types) by the Government. Develop suitable financial mechanisms to support the implementation of the Programme, such as: targeted grant co-financing, soft loans, ESCO, budget capturing, revolving fund mechanisms, etc. • Ensure co-financing to support the renovation programme for private service and commercial buildings (targeting all or a specific number of building types) by the Government. Develop targeted group specific suitable financial mechanisms to support the implementation of the Programme, such as: targeted grant co-financing, soft loans, tax exemption etc. When providing financial incentives to owners of buildings or building units for the renovation of rented buildings or building units, the Government shall aim at financial incentives benefiting both the owners and the building users.
Investment needs and funding sources	Estimated investment needs until 2030: approx. 200,000 Euro (TA for the development of financial mechanisms). Estimated budget costs to establish the National EE Fund and operationalization: 300,000 Euro. Funding source: MoIE supported by different donors like EBRD, WB or WBIF

IV.5.7 Inspection of Building Technical Systems

Following box presents main aspects for Inspection of Building Technical Systems.

Title of measure BRP reference NECP reference:	**Inspection of Building Technical Systems** 7 EE-I1
Type of Instrument	Regulatory and Technical
Date of entry into force	2025
Timeframe / implementation period	2025 – ongoing
Legal basis and planning documents	Law on Energy Performance in Buildings
Actions taken to date / status of implementation	No actions taken to date, new activity
Main Objective / quantified objective	To ensure the Technical Building Systems are operated at the highest efficiency.
Results to be achieved / expected impact	Establishing a system for the inspection of technical systems in buildings.
Measures to be implemented / short description	• Establish a database for inspection reports incl. independent control system. • Draft guideline on inspection of technical building systems (TBS). • Drafting and approving the format for the TBS inspection report. • Training and certification of independent expert for TBS inspection. • Defining the framework for the verification, inspection and promotion. • Development of One-Stop Shops for promotion of energy efficiency in buildings.
Investment needs and funding sources	Estimated budget needs until 2030 (training, guidelines, etc.): approx. 200,000 EUR Funding source: IFIs Technical Assistance Program
Implementing Entity	Municipalities, regional associations, Ministry of Infrastructure and Energy Ministry of Infrastructure and Energy

IV.5.8 Energy efficiency obligation scheme and alternative measures for Albania

Following box presents main aspects for the energy efficiency obligation scheme and alternative measures for Albania.

Title of measure BRP reference NECP	**Energy efficiency obligation scheme and alternative measures for Albania** 8 EE-O1
Type of Instrument	Regulatory
Date of entry into force	2023
Timeframe / implementation period	2023-2030

Legal basis and planning documents	Law No. 124/2015 of 12.11.2015 "On Energy Efficiency" amended by the Law No. 28/2021 "On some amendments and additions of Law No.124/2015 on energy efficiency". Obligation under Article 7 of the EE Directive transposed in the Law No.124/2015 as amended
Actions taken to date / status of implementation	Law No. 28/2021 "On some amendments and additions of Law No.124/2015 on energy efficiency has created the basis for implementation of the obligation schemes and alternative measures for distributors, operators and/or suppliers on the energy markets in the Republic of Albania for achieving savings in final energy consumption.
Main Objective / quantified objective	• Setting targets for end-use energy savings (this applies to all energy types, including electricity, gas, and solid fuel), which distribution system operators and / or suppliers energy markets are obliged to apply. • From a rough calculation based on benchmark the expected savings will be 37 ktoe in 2030. • Implementation of the obligation schemes will contribute to reach the BRP targets for public buildings and energy poor households.
Results to be achieved / expected impact	• Rational use of energy sources at national level • Achievement of the cumulative energy savings objectives of total final energy demand at national level up to 31 December 2030 • Reaching the target from obligation parties (OP) approximately 1,5 % of the annual energy sales to final customers of all energy distributors or all retail energy sales companies averaged over the three-year period; (EED, Article7) • Companies who sell large amounts of energy are known as obligated parties and they have targets under the scheme. Obligated parties offer supports to make others home or business more energy efficient. For every unit of energy saved through these projects, they achieve energy credits towards their targets. The support they provide to you may be technical, financial, or a mixture of both. This will also help Albania to reach national energy saving targets.
Measures to be implemented / short description	By 2026 - Preparation work for regulatory framework for establishment of obligation scheme: • A scheme for 2023-2030, outlining who should be obligated, the size of the target and how these targets will be delivered has to be designed, including approved EE measures to be implemented by the end users with support of distributor operators and/or suppliers on the energy markets By 2027 - Legal framework: • A DCM for establishing an energy efficiency obligation scheme should be adopted by the Government, that will set up targets for end-use energy savings, which distribution system operators and / or suppliers energy markets are obliged to apply
Investment needs and funding sources	Source: state budget or IFI source Since this is a regulatory instrument, the budget is related to the technical assistance needed (first evaluation is 10,000 – 20,000 EUR).
Implementing Entity	Ministry of Infrastructure and Energy; Albanian Energy Efficiency Agency; Obligation Parties (OP), Consumers Monitoring: Ministry of Infrastructure and Energy; Albanian Energy Efficiency Agency)

IV.5.9 Uptake of ESCO models

Following box presents main aspects for introducing important ESCO financial mechanism for all sectors.

Title of measure BRP reference NECP reference:	**Uptake of ESCO models** 9 EE-S1
Type of Instrument	Regulatory
Date of entry into force	2022
Timeframe / implementation period	2022 – ongoing
Legal basis and planning documents	Law on EE EED

Actions taken to date / status of implementation	• *There are existing ESCOs but not certified specifically for energy efficiency.* • *Article 18 of the Law No. 28/2021 "On some amendments and additions of Law No.124/2015 on energy efficiency" has created the basis for establishing ESCOs.* • *Guideline of Minister of Infrastructure and Energy No 23 of 17.10.2022 "On the contract model for energy performance contracting"*
Main Objective / quantified objective	Ensure the required legal environment for ESCO investments to be enabled for public and private sector buildings.
Results to be achieved / expected impact	Introducing and establishment of ESCOs will enable the high-quality services for EE/RES investments and may serve as financing, thus reducing the up-front costs for the building owner.
Measures to be implemented / short description	The objective of this measure is to promote EE/RES investments in the public and private sector through ESCO mechanism. Under an energy performance contract, an ESCO (Energy Service Company) undertakes a project to deliver energy efficiency and renewable energy improvements in the premises of the client and uses the stream of income from the cost savings to repay the costs of the project. **Activities:** By 2026 - **Preparation of Contract model:** • Preparation of the Contract model by the Order of the Minister • Subject matter of the Contract is the implementation of Energy Conservation Measures (ECMs) for improving the efficient use of Energy and corresponding reduction of CO_2 emissions and reducing the Operating Costs in the Contracted Facility. • The Contractor takes upon itself to implement such ECMs, through which he will ensure Operational Cost Savings in the Contracted Facility during the Guarantee Period, in accordance with this Contract (including all the Appendices). • All ECMs applied under this Contract must be in accordance with applicable regulations and required standards in Republic of Albania. By 2026 - **Support measures:** • The Agency responsible for Energy Efficiency (AEE) publishes on its website: (i) best practices for energy performance contracting, guidelines, model contracts including provisions to be included in such contracts to guarantee energy savings and end-user rights; (ii) the list of qualified / registered energy service providers, which must be updated regularly; and (iii) (iii) information on any available financial instruments, incentives, grants, and loans to support energy efficiency service projects.
Investment needs and funding sources	Estimated investment needs until 2030: approx. 100,000 Euro Funding source: MoIE supported by different donors like EBRD, WB, EIB, GiZ, EU, etc.
Implementing Entity	Ministry of Infrastructure and Energy, ESCOs, public and private building owners, Energy Efficiency Agency

IV.5.10 Alignment of Municipalities Energy and Climate Action Plans with the BRP

Following box presents main aspects for the Alignment of Municipalities Energy and Climate Action Plans with the BRP. It is very important to be notice that Space Heating, Cooling, Hot Water Energy MAPS for Albania and each Municipalities prepared under this top-important report "Comprehensive assessment of the potential for efficient heating and cooling (HAC) in Albania in full compliance with the requirements of the Energy Efficiency Directive (EU/2023/1791)" will serve directly for proper preparation of MECAP.

Title of measure BRP reference NECP	Alignment of Municipalities Energy and Climate Action Plans with the BRP 10 EE-P2 (amended)
Type of Instrument	Regulatory
Date of entry into force	2022
Timeframe / implementation period	2022 – ongoing

Legal basis and planning documents	Law No. 124/2015 of 12.11.2015 "on Energy Efficiency", amended; DCM No. 709 of 1.12.2017 "on the Approval of the second and third Action Plan for the Energy Efficiency 2017 – 2020" Order of Minister of Infrastructure and Energy No 206 of 25.10.2022 "On the approval of the format of local action plans for energy efficiency and the progress report for the implementation of the plans" Decision of Council of Ministers No 189 of 5.04.2023 "On the approval of the monitoring and verification platform"
Actions taken to date / status of implementation	• Draft BRP developed with targets for municipal level buildings • Creation of legal framework • NECP developed
Main Objective / quantified objective	Involvement of municipalities into the execution of the BRP by defining their own EE renovation actions/measures within their Municipal Energy and Climate Action Plans (based on BRP defined targets for municipal buildings) as a driving force, and by monitoring the implementation of measures to reduce energy consumption and reduce emissions.
Results to be achieved / expected impact	Decarbonization of municipal public buildings, including: • Increasing the capacity building to the employees of the municipalities in the EE field • Detailed plan on EE/RES measures for municipal building stock in accordance with BRP • Providing EE investments financing sources • Monitoring the implementation of the EE measures • Monitoring and reporting of energy consumption and savings realized to EEA
Measures to be implemented / short description	Activities: • This report "Comprehensive assessment of the potential for efficient heating and cooling (HAC) in Albania in full compliance with the requirements of the Energy Efficiency Directive (EU/2023/1791)" will serve directly for proper preparation of Municipal Heat Maps • Alignment of Municipalities Energy and Climate Action Plans with the BRP as an obligation defined by the Law on EE. • Allocate enough financial investments (budget allocation) to ensure financing of municipal public buildings • Setting up a monitoring and verification platform - creating the legal framework and setting up the operational framework • Support for the extension of the national energy management framework; • Strengthening capacities for project design and implementation of EE/RE investments within public buildings; • Strengthening of key institutions at the local and national level related to energy management.
Investment needs and funding sources	Estimated investment needs until 2030: approx. 30,000-80,000 Euro per municipality Funding source: EEA supported by different donors like SECO, GIZ, UNDP
Implementing Entity	Ministry of Infrastructure and Energy, Municipalities, ESCOs, energy managers, end-users

IV.5.11 Energy spatial planning for increasing the share of renewable energy and improve energy efficiency

Following box presents main aspects for the implementation of energy spatial planning for increasing the share of renewable energy and improve energy efficiency.

Title of measure BRP reference NECP reference:	Energy spatial planning for increasing the share of renewable energy and improve energy efficiency 11 R-E3
Type of Instrument	Regulatory
Date of entry into force	2023
Timeframe / implementation period	2023 – ongoing

Legal basis and planning documents	Law No. 107/2014 of 31.7.2014 "on Territorial Planning and Development", amended and related bylaws Law No. 81/2017 of 4.5.2017 "on Protected Areas" and related bylaws Renewable Energy Directive (REDII, amended by Directive (EU) 2023/2413)
Actions taken to date / status of implementation	No actions taken to date, new activity. • State Authority for Geospatial Information (ASIG) provides a GIS that can be built upon: https://geoportal.asig.gov.al/en/services
Main Objective / quantified objective	To identify priority areas for energy-related land use, in order to simplify and accelerate permit procedures and increase investment security
Results to be achieved / expected impact	An officially approved and publicly accessible map which displays priority areas for the use of specific renewable energy sources, building renovations, and other energy-related actions relevant for project developers
Measures to be implemented / short description	Activities: By end of 2025 • Regulatory: The procedure for developing the map and the explanatory document must be defined, as well as the procedure for public consultation, approval and revision of the map and the explanatory document. By end of 2026 • Technical: Scientific study resulting in a map, supplemented by an explanatory document; exemplary content: • Photovoltaic capacities: With regard to land use, there are conflicting goals (e.g., with ecosystem services of open spaces) and synergy effects (e.g., multiple uses of PV in landfill areas and as noise protection along highways and railroads; floating PV on reservoirs and use in port areas; large roof areas of storage halls, industries, etc.;). These opportunities are identified and located. • Waste heat capacities need to be surveyed and located and potential uses identified. • Building renovation needs are identified and located as the basis for developing optimized demand side and supply side measures, making the best use of renewable energy sources. From 2026 • Public consultation and revision of study • Approval of map and explanatory document • Publication of map and explanatory document
Investment needs and funding sources	Estimated investment needs until 2030: Preparation of legal framework and scientific study to be financed by Technical Assistance Programme, approx. 500,000 EUR Funding source: IFIs Technical Assistance Program
Implementing Entity	Ministry of Infrastructure and Energy; EE Agency

IV.5.12 Mechanism of net metering for installations up to 500 kW

Following box presents main aspects for the implementation of the mechanism of net metering for installations up to 500 kW.

Title of measure BRP reference NECP	Mechanism of net metering for installations up to 500 kW 12 R-E4
Type of Instrument	Regulatory
Date of entry into force	2017
Timeframe / implementation period	2017 - ongoing
Legal basis and planning documents	Law No 24/2023 of 23.03.2023 "On promoting the use of energy from renewable sources".

	Guideline of the Minister of Infrastructure and Energy No. 3 of 20.6.2019 "on the Approval of the Simplified Authorisation Procedure for the Connection with the Distribution Grid of Small Renewable Projects of Self producers of Electric Energy from Solar Sources"
Actions taken to date / status of implementation	OSHEE has already included in its website the standards applicable to the meter but does not have a database of the projects already implemented. Total installed capacity is around 160 MW.
Main Objective / quantified objective	The objective is to encourage households and consumers (up to an installation of 500 kW) to install renewable capacity and to promote self-consumption.
Results to be achieved / expected impact	• Increase of energy production from renewable sources to ensure a sustainable development in the Republic of Albania, in accordance with the obligations under the Energy Community Treaty • This measure also contributes to the National Target on RES till 2030 related to the share of renewable sources compared with the Gross Final Energy Consumption and specifically to reach the target for renewable energy for electricity generation • The increase of renewable capacity, mostly PV, is not presented separately for this measure but the total capacity is supposed to be reflected in the NECP measure R-E1. • The increase of self-consumption will improve the energy security by diversifying the generation sources of the electricity sector.
Measures to be implemented / short description	Activities: The following scheme is implemented based on the law 7/2017: • According to the renewable energy law of 2017, a small or medium-sized company or a household customer can install a total capacity of up to 500 kW to generate electricity from wind or solar to cover some or all of the energy needed for the needs and inject the excess energy produced in the distribution network. • Customers, according to the net energy metering scheme, must install at their own expense a two-way meter. • Net balance and billing are done on a monthly basis for each metering point. Surplus electricity greater than monthly consumption is sold to the universal service provider, charged with the public service obligation, according to the price set by the ERE, based on the methodology approved by the Council of Ministers, on the proposal of the Minister. The following scheme is implemented based on the law 24/2023: • The concept of renewables self-consumers established in Albania by Law no. 24/2023 is expanding the empowerment of final customers. Renewables self-consumers shall have a maximum capacity of 500 kW and shall have the right to generate, consume, store and sell their excess production of renewable electricity, individually or through aggregators, including through bilateral agreements, electricity suppliers and peer-to-peer trading arrangements. • The compensation scheme of renewables self-consumers based on a net-billing methodology from 1 January 2024. • Connection procedure and DSO/OSHEE authorization: A streamlined and simplified connection procedure should be established to shorten the connection time and decrease administrative costs. There are currently about 700 PV Autoproducers based on the annual report of ERE for the year 2024. This number is very small compared to the high number of all consumers of all sectors, approximately 1,100,000. For a penetration rate of 10% by 2030, the number of PV Autoproducers will be approximately 120,000, assuming an increase in the number of consumers by 100,000 by 2030. Based on the above assumptions, each year (for the period 2025-2030) OSHEE will have to handle approximately 15,000 requests per year (or 1250 requests per month). This will be a very large volume of work to be handled and stored in the traditional actual way and it is suggested to switch to electronic applications using e-Albania as a very successful platform used so far by all sectors and OSHEE for their billing system. OSHEE, with the help of donors, has all the possibilities to build this application in e-Albania to guarantee fast permitting, which will help to a quick penetration of PV Autoproducers in the Albanian market. • PV Autoproducers targets: The target should be clearly set, for instance as the share of roof-top PV capacity in the total national renewables target. Actually, total peak demand is approximately 1500 MW (year 2022) and for the year 2030 will be 2000-2100 MW. Assuming, a rate of penetration of 10% for PV Autoproducers on the year 2030, the respective target shall be 200-210 MW. • The renewables self-consumer's installation may be owned by a third party or managed by a third party for installation, operation, including metering and maintenance, provided that the third party

	remains subject to the renewable self-consumer's instructions. The third party itself is not considered a renewables self-consumer. • Renewables self-consumers located in the same building, including multi-apartment blocks, are entitled to engage jointly as renewables self-consumers and are permitted to arrange sharing of renewable energy that is produced on their site or sites between themselves. • Approval of the Simplified Authorisation Procedure for the Connection with the Distribution Grid of Small Renewable Projects of Self producers of Electric Energy from Solar Source.
Investment needs and funding sources	Estimated investment needs until 2030: - No state budget foreseen because the cost of scheme is indirectly covered by the electricity tariff. There is no payment towards producers, only a reduction in their electricity bills.
Implementing Entity	OSHEE, Private companies, RES Operator (to be established according to RES Law).

IV.5.13 Supporting the formation of renewable energy communities

Following box presents main aspects for supporting the formation of renewable energy communities.

Title of measure BRP reference NECP	Supporting the formation of renewable energy communities 13 R-E9
Type of Instrument	Regulatory
Date of entry into force	2024
Timeframe / implementation period	2024 – ongoing
Legal basis and planning documents	Law No 24/2023 of 23.03.2023 "On promoting the use of energy from renewable sources" Renewable Energy Directive (REDII, amended by Directive (EU) 2023/2413)
Actions taken to date / status of implementation	No action taken to date
Main Objective / quantified objective	Fostering a renewable energy revolution: With Directive on the promotion of the use of energy from renewable sources (EU) 2018/2001 (REDII) and Directive on common rules for the internal electricity market (EU) 2019/944, the European legislator not only introduced a comprehensive reorganisation of the European funding and subsidies framework in the field of renewable energy, but also addressed the issue of citizen participation in order to foster a renewable energy revolution in Europe. Enhancing self-consumption: Supporting the citizens is an instrument to enhance self-consumption in suitable areas and transform them into renewable energy communities (according to article 21 and article 22 REDII). According to REDII article 2 (16) 'renewable energy community' means a legal entity: (a) which, in accordance with the applicable national law, is based on open and voluntary participation, is autonomous, and is effectively controlled by shareholders or members that are located in the proximity of the renewable energy projects that are owned and developed by that legal entity; (b) the shareholders or members of which are natural persons, SMEs or local authorities, including municipalities; (c) the primary purpose of which is to provide environmental, economic or social community benefits for its shareholders or members or for the local areas where it operates, rather than financial profits. Good examples can be found at https://www.rescoop.eu/
Results to be achieved / expected impact	Establishment of renewable energy communities
Measures to be implemented /	Activities: By end of 2025: • To carry out a screening study to clarify which support is needed and which municipalities would qualify for pilot & demonstration activities because there is an active civil society initiative.

short description	• Draft secondary legislation that provides for the implementation of renewable energy communities. By end of 2026: • Put in place the organisational and promotional support structure. • Support the establishment of selected pilot renewable energy communities and promote them.
Investment needs and funding sources	Estimated investment needs until 2030: Screening study and development of legal and organisational framework to be financed by a Technical Assistance Program, approx. EUR 150,000. Support for pilot projects with selected renewable energy communities to be financed by a Technical Assistance Program, approx. EUR 20,000 per renewable energy community. Funding source: IFIs Technical Assistance Program
Implementing Entity	Municipalities, Distribution company OSSH, Energy Regulatory Entity

IV.5.14 Municipal Heat Maps

Following box presents main aspects for the preparation of Municipal Heat Maps. It is very important to be notice that Space Heating, Cooling, Hot Water Energy MAPS for Albania and each Municipalities prepared under this top-important report "Comprehensive assessment of the potential for efficient heating and cooling (HAC) in Albania in full compliance with the requirements of the Energy Efficiency Directive (EU/2023/1791)" will serve directly for proper preparation of Municipal Heat Maps.

Title of measure BRP reference NECP	Municipal Heat Maps 14 R-E11
Type of Instrument	Regulatory
Date of entry into force	2024
Timeframe / implementation period	2024 – 2030
Legal basis and planning documents	Law No 124/2015 of 12.11.2015 "On energy efficiency" Guideline of Minister of Infrastructure and Energy No 2 of 1.02.2023 "On elements, requirements and general principles of cost-benefit analysis for assessing the potential of application for high efficiency cogeneration and efficient heating and cooling"
Actions taken to date / status of implementation	This report "Comprehensive assessment of the potential for efficient heating and cooling (HAC) in Albania in full compliance with the requirements of the Energy Efficiency Directive (EU/2023/1791)" will serve directly for proper preparation of Municipal Heat Maps.
Main Objective / quantified objective	To contribute to the decarbonisation of heating (including provision of domestic hot water)
Results to be achieved / expected impact	Municipal heat maps as a basis for decision making for decarbonising the heat supply
Measures to be implemented / short description	Activities: By end of 2025: • Identify the location of current heating demand as well as supply on a map • Identify renewable energy potential to supply heating for a selected area; • Calculate the potential for efficient district heating options within a selected area; Estimate and compare the costs of individual heating vs. district heating options within a selected area; By end of 2026: • Legal framework for implementing heat maps as part of energy spatial planning
Investment needs and funding sources	Estimated investment needs until 2030: approx. 500,000 EUR Funding source: IFIs Technical Assistance Program

Implementing Entity	*Municipalities; Ministry of Infrastructure and Energy*

IV.5.15 Policies to support RES in Heating and Cooling Sector including CHP systems

Following box presents main aspects for Policies to support RES in Heating and Cooling Sector including CHP systems.

Title of measure BRP reference NECP reference	Policies to support RES in Heating and Cooling Sector including CHP systems 15 G-B1
Type of Instrument	Regulatory
Date of entry into force	2017
Timeframe / implementation period	2017 – 2030
Legal basis and planning documents	Law No 24/2023 of 23.03.2023 “On promoting the use of energy from renewable sources” Law on Energy Performance of Buildings Law on Energy Efficiency
Actions taken to date / status of implementation	Up to now, activities on increasing the capacities in the central and local government units (municipalities) have been taken. 70% of solar heating panels for hot water (solar thermal systems) were subsidized by the government of Albania for 2000 installations. The new law foresees a scheme for supporting RES in Heating and Cooling Sector.
Main Objective / quantified objective	Promote the widespread use of renewable energies in the heating and cooling sector
Results to be achieved / expected impact	Increase the installed capacity of RES in buildings
Measures to be implemented / short description	Activities: This report “Comprehensive assessment of the potential for efficient heating and cooling (HAC) in Albania in full compliance with the requirements of the Energy Efficiency Directive (EU/2023/1791)” will serve directly to support RES in Heating and Cooling Sector including CHP systems. By end of 2030: • DCM to support the achievement of National target for renewable energy sources in the heating and cooling sector. • Minimum indications for the use of solar energy, to be placed considering the amount of solar radiation for different areas of the country. • Approval of the specific criteria for the calculation of used solar energy to obtain hot water in particular or as part of the energy code of the buildings taking into account the latest EU standards adopted for this purpose. • Regulatory schemes for the installation of photovoltaic panels both in residential and other sectors. • Financial incentive schemes for solar thermal systems in connection with: o Continuation of the solar thermal incentive scheme: 70% of solar heating panels for hot water (solar thermal systems) subsidized by the government of Albania for 2000 installations o Household measures such as improving energy efficiency of the heating systems, modernisation and expansion of efficient heating systems, fuel change, etc. o Heating system improvement (HIS) for common buildings, such as the installation of simple and low-cost equipment, conducting simple energy audits along with education campaigns, fuel change; • Regulatory schemes for approving the support scheme for achieving the national objective for renewable energy sources in the heating and cooling sector". • Regulatory scheme for fossil fuel boiler replacement. • Guidelines on the application procedure along with best practices and advantages.

	• Combining the above measures with the retrofitting programs developed by municipalities and central government.
Investment needs and funding sources	Estimated investment needs until 2030: The cost of the solar thermal scheme is covered by the financial incentive schemes funded by state budget (estimate: EUR 1,200 per system, funding 70%, 2000 installations: budget for incentive scheme is EUR 1,680,000.00; estimation according to https://balkangreenenergynews.com/albania-to-subsidize-solar-thermal-collectors-for-households-with-up-to-70/). First programme was finalised during the period 2021-2022 and have been installed 2000 residential Solar Hot Water Systems (SHWSs), which are generating every year approximately 4500 MWh/year. A second call for second group of 2000 houses for installing Solar Hot Water System was open on February 10, 2025 and closed by end of April 2025. Total programme for installation of 2000 panels of the solar thermal scheme is covered by the financial incentive schemes funded by state budget (estimate: EUR 1,350 per system, 2000 installations: budget for incentive scheme is EUR 2,000,000.
Implementing Entity	Ministry of Infrastructure and Energy, municipalities

IV.5.16 Creation of one-stop shops for the energy performance of buildings and industry

Following box presents main aspects for creation of one-stop shops for the energy performance of buildings and industry.

Title of measure BRP reference NECP	Creation of one-stop shops for the energy performance of buildings 16 Not included in NECP
Type of Instrument	Awareness
Date of entry into force	2026
Timeframe / implementation period	2026 - ongoing
Legal basis and planning documents	Law on energy performance of buildings EPBD (Article 18) EED
Actions taken to date / status of implementation	• *Law on EPB developed* • *BRP identified measure for creation of one-stop shops*
Main Objective / quantified objective	The key objective is to provide independent advice on the energy performance of buildings in particular the renovation of buildings and to offer dedicated services for different client groups such as: vulnerable households, people affected by energy poverty, home owner association, etc.
Results to be achieved / expected impact	An online/web-based one-stop stop, accessible to all Albanian's inhabitants, is operational and provides advice on energy performance of buildings.
Measures to be implemented / short description	The Albanian government shall, in cooperation with competent authorities, and, where appropriate, private stakeholders, ensure the establishment and the operation of technical assistance facilities through online/web-based one-stop shops for the energy performance of buildings, targeting all actors involved in building renovations, i.e., homeowners and administrative, financial and economic actors, such as SMEs, including microenterprises. One-stop shop (OSS) can be defined as a collective term for services offering integrated renovation solutions with the main intention of simplifying the renovation process for homeowners and/or market participants. OSS should provide information and support for renovations to all targeted group of the BRP (residential, public and commercial) in regard to: • General benefits of EE/RES measures, explanation of Deep and ZEB measures, identification of EE/RES measures for different building types, support in selection of companies and energy auditors. • Financing options for different targeted groups, and co-fin and grant financing.

	• Renovation work, worksite supervision and quality assurance and guarantees for technical systems and materials post to completed measures. • Advise on energy consumption behaviour. • Technical and financial possibilities and solutions to households, SMEs including microenterprises, and public bodies. • Support to all households, with a particular focus on households affected by energy poverty and on worst-performing buildings, as well as to accredited companies and installers providing retrofit services, adapted to different housing typologies and geographical scope, and provide support covering the different stages of the retrofit project. Special focus shall be given to energy poverty and dedicated services for vulnerable households. Activities: • DCM to establish OSS for the energy performance of buildings, as per EPBD requirements of Article 18, and as an integrated part of the e-Albania platform. • The Government should ensure the continuous financing of OSS and it's monitoring and operational staff and working materials (such as apps, information points, etc.). • The EEA and MoIE, should develop a three-year plan implementation plan on supporting the implementation of BRP indicators and targets. • Coordination of OSS activities with BRP programme execution/implementation. • Ensure that OSS activities are monitored and reported to local level and national level governments and EEA.
Investment needs and funding sources	Estimated investment needs until 2030: 1.0 Mio EUR Source of funding: state budget
Implementing Entity	Government of Albania, EEA, National Agency for the Information Society

IV.5.17 Deployment of solar energy installations on buildings and industry

Following box presents main aspects for the deployment of solar energy installations on buildings and industry.

Title of measure BRP reference NECP	**Deployment of solar energy installations on buildings and industry** 18 Not included in NECP
Type of Instrument	Regulatory
Date of entry into force	2026
Timeframe / implementation period	2026 – ongoing
Legal basis and planning documents	Law on energy performance of buildings (Article 18) EPBD (Article 10)
Actions taken to date / status of implementation	• *Law on EPB developed* • *ZEB measures, as per BRP, include solar energy utilization*
Main Objective / quantified objective	All new buildings are designed optimizing their solar energy utilization potential based on the solar radiation of the area and enabling the subsequent cost-effective installation of solar technologies; while existing buildings which undergo ZEB, renovations include cost-effective installation of solar technologies.
Results to be achieved / expected impact	Residential building stock: • retrofitting 75% of worst-performing residential buildings according to ZEB concept. • retrofitting 75% of all other residential buildings (not WPB) according to ZEB concept. • All new residential buildings are build based on the ZEB concept

	Public building stock: • Most of the Central and Municipal Public Buildings will be retrofitted according to ZEB concept. • All new Central and Municipal Public Buildings will be according to the ZEB concept Private Service and Commercial building stock: • Most of the existing Private Service and Commercial Buildings will be retrofitted according to ZEB; and • All new Private Service and Commercial Buildings to be constructed according to the ZEBs
Measures to be implemented / short description	The Government should ensure the deployment of suitable solar installations on new buildings, both residential and non-residential, and on existing non-residential and where possible also residential buildings. As per Law on EPB, starting from 2026, all new buildings should be designed to optimize their solar energy utilization potential based on the solar radiation of the area and enabling the subsequent cost-effective installation of solar technologies. Activities: • Upon proposal of the MoIE and the Ministry responsible for territorial development planning, the Council of Ministers approves a national scheme for the installation of systems using solar energy in buildings, which includes facilitating rules for the realization of installations, based on the analysis of the impact of the increase in generation from photovoltaic capacities in the distribution network. • MoIE should establish criteria for the implementation of, and possible exemptions from, the deployment of solar installations on buildings, in line with the assessed technical and economic potential of the solar energy installations and the characteristics of the buildings covered by the obligation from the Law, taking into account the principle of technology neutrality and the combination of solar installations with other roof uses, such as green roofs or other building services installations. • The national scheme for the installation of systems using solar energy in buildings should follow the as per law defined thresholds: o from 31 December 2028, all new public buildings and non-residential buildings, with a useful area greater than 250 m2 o all existing public buildings, with a useful area greater than: - 2000 m2, as of December 31, 2028; - 750 m2, as of December 31, 2029; - 250 m2, as of December 31, 2030; o as of 31 December 2029, existing non-residential buildings, with a useful area greater than 500 m2, where the building is subject to a significant renovation or an action requiring an administrative permit for the renovation of the building, including works on the roof or installation of technical systems o from December 31, 2029, new residential buildings o From December 31, 2029, new covered resorts for mobile vehicles, physically positioned next to the buildings • Ensure that the deployment of solar energy installations on buildings is reflected in EPC. • Monitor the results of the national scheme for the installation of systems using solar energy in buildings.
Investment needs and funding sources	Estimated cumulative investment needs for the period 2025-2030: 50,000 Euro Funding source: Home owners, State Budget, Private Owners, Banks, IFIs, Donors
Implementing Entity	MoIE, Government of Albania, EEA, energy auditors

IV.5.18 Promotion of district heating, CHP schemes (and triple generation: heating, cooling and power) and neighbourhood approaches and integrated renovation programmes at district level,

addressing issues such as energy, mobility, green infrastructure, waste and water treatment and other aspects of urban planning

Following box presents main aspects for promotion of district heating, CHP schemes (and triple generation: heating, cooling and power) and neighbourhood approaches and integrated renovation programmes at district level, addressing issues such as energy, mobility, green infrastructure, waste and water treatment and other aspects of urban planning.

Title of measure BRP reference NECP reference	**Promotion of district heating, CHP schemes (and triple generation: heating, cooling and power) and neighbourhood approaches and integrated renovation programmes at district level, addressing issues such as energy, mobility, green infrastructure, waste and water treatment and other aspects of urban planning** 19 not included in the NECP
Type of Instrument	Regulatory / Awareness
Date of entry into force	2026
Timeframe / implementation period	2026 – ongoing
Legal basis and planning documents	EPBD EED RED Law Nr. 107/2014 Planning and Territorial Development Law Nr. 8402 10.09.1998 On control of the works of construction Law Nr. 33/2012 On registration of immovable properties
Actions taken to date / status of implementation	All Municipality Energy and Climate Action Plans (MECAP) are required to include the promotion of district and neighbourhood approaches and integrated renovation programmes at district level, addressing issues such as energy, mobility, green infrastructure, waste and water treatment and other aspects of urban planning.
Main Objective / quantified objective	Promote district and neighbourhood approaches and integrated renovation programmes at district level, which may address issues such as energy (including district cooling), mobility, green infrastructure, waste and water treatment and other aspects of urban planning, and may take into account local and regional resources, circularity, sufficiency, as well as nature-based solutions.
Results to be achieved / expected impact	Integrated renovation plans, district or neighbourhood approaches are taken into consideration while applying the renovation programme into a number of buildings in a spatial context instead of a single building.
Measures to be implemented / short description	Integrated district or neighbourhood approaches help to increase the cost-effectiveness of the renovations required for buildings that are spatially related such as housing blocks. Such approaches to renovations offer a variety of solutions at a larger scale - by integrating buildings and neighbourhood infrastructure, they create opportunities for sufficiency measures and increased ambition of energy performance. These solutions imply a strong focus on sustainable behaviour, occupant satisfaction, co-design with residents, shared services and infrastructure, and close collaboration between private and public stakeholders in the local community Activities: • While planning new building blocks on city or municipal level, and renovation programmes aiming to be executed within several or all MABs within a building block or neighbourhood, integrated district or neighbourhood approaches (including district cooling) shall be taken into account by urban planners, designer and private and public investors. • The MoIE and cities and municipalities should promote district and neighbourhood approaches and integrated renovation programmes at district level, including solutions related to energy performance, mobility, green infrastructure and nature-based solutions, waste and water treatment and other aspects of urban planning, as well as circularity and sufficiency, and district cooling. • Promote public-private partnerships to enable investments into integrated district/neighbourhood approaches projects.
Investment needs and funding sources	Estimated investment needs until 2030: 100,000 EUR for awareness raising activities Funding source: state budget

Implementing Entity	Urban planners and designers, departments for local level/municipal planning within local governments, private and public investors, MoIE

IV.5.19 Addressing skills gaps and promoting education, targeted training, upskilling and reskilling in the construction sector and energy efficiency and renewable energy sectors

Following box presents main aspects for addressing skills gaps and promoting education, targeted training, upskilling and reskilling in the construction sector and energy efficiency and renewable energy sectors.

Title of measure BRP reference NECP reference	Addressing skills gaps and promoting education, targeted training, upskilling and reskilling in the construction sector and energy efficiency and renewable energy sectors 22 Not included in NECP
Type of Instrument	Awareness
Date of entry into force	2026
Timeframe / implementation period	2026 – ongoing
Legal basis and planning documents	Law on EPB EPBD
Actions taken to date / status of implementation	Law on EPB developed
Main Objective / quantified objective	Link universities/faculties curriculum and training programmes for reskilling of workers with the sectoral buildings' decarbonization goal.
Results to be achieved / expected impact	A workforce able to plan, design and apply DEPP/ZEB technologies and solutions within Albania's building sector.
Measures to be implemented / short description	Government policies on minimum energy performance standards serve as crucial guidance for energy professionals, shaping their skill set needs and professional obligations. However, with the Law on EPB only beginning to gain traction in the public discourse in regard to Deep and ZEB requirements, there is a lack of awareness among professionals regarding its implications and potential opportunities for development – the energy professionals and the construction sector is missing knowledge and skills on ZEB technologies (ability to design and apply). The current expertise among designers, engineers, installers, and workers to implement new technologies aimed at achieving high-efficient buildings are limited. There is a lack of trainings for designers, installers and energy auditors on ZEB technologies. Investment in the improvement of the human capital stock is low, limiting the creation of a more productive workforce. Activities: • The EEA, in cooperation with MoIE and any other relevant ministries and authorities (Ministry of Health and Social Protection), drafts the strategy for the country's training programme on addressing skills gaps and promoting education, targeted training, upskilling and reskilling in the construction sector and energy efficiency and renewable energy sectors of stakeholders. • The EEA, in cooperation with MoIE and any other relevant ministries and authorities, supports the development and execution of specific target group trainings on Deep and ZEB technologies and solutions, including the upskilling and reskilling in the construction sector. Ministry of Education, Sports and Youth and VET schools, in cooperation with MoIE and any other relevant ministries and authorities, includes within the current curriculum of technical universities/faculties lectures and subjects related to ZEB technologies and construction and energy supply standards, Albania's decarbonization goals, etc., in their regular higher-education programmes. • The EEA and any other relevant ministry and authority, reports on the progress of the strategy each year to the MoIE.

Investment needs and funding sources	Estimated investment needs for the period 2026-2027: 300,000 Euro Funding source: State Budget
Implementing Entity	MoIE, EEA, Ministry of Education, Sports and Youth, Ministry of Health and Social Protection, VET Schools

IV.5.20 Awareness-raising campaign

Following box presents main aspects for carrying out successfully Awareness-raising campaign for boosting EE/RES measures for meeting Heating and Cooling energy demand for all sectors.

Title of measure BRP reference NECP	Awareness-raising campaign 23 Not included in NECP
Type of Instrument	Awareness
Date of entry into force	2025
Timeframe / implementation period	2025 – ongoing
Legal basis and planning documents	Law on EPB – article 32 EPBD 2024/1275 – article 29
Actions taken to date / status of implementation	Law on EPB developed
Main Objective / quantified objective	Support the implementation of the BRP targets by creating awareness and interest for renovation/investment into EE/RES.
Results to be achieved / expected impact	Increased awareness on benefits of EE/RES investments of owners and tenants of buildings or building units and all relevant market actors, such as local and regional authorities and energy communities, including awareness on the different methods and practices that serve to enhance energy performance of buildings.
Measures to be implemented / short description	A country-wide awareness raising campaign should be developed and executed, in order to support the BRP's targets and renovation programmes of each of the three sectors (residential, public and commercial). Activities: • The EEA, in cooperation with MoIE, drafts the strategy for the information and training campaign of stakeholders on measures, Deep and ZEB renovation goals and benefits, financing mechanisms, benefits and awareness related to energy efficiency, as per Law on EPB. • The EEA prepares the necessary guidelines and trainings for the obligated parties and stakeholders (as per Lae on EPB) which emphasize the importance of improving energy performance and that facilitate the consideration of optimal improvements in energy efficiency, reduction of greenhouse gases, use of renewable energy sources as well as the use of central heating and cooling during planning, design, construction and renovation of commercial and residential building stock. • The campaign includes renovation advice and communication of the existence of one-stop shops, paying particular attention to vulnerable households. • The EEA reports on the progress of the strategy each year to the MoIE.
Investment needs and funding sources	Estimated investment needs until 2030: approx. 300,000 EUR (radio, TV and social media campaigns) Funding source: state budget
Implementing Entity	EEA, MoIE

IV.6 Final Energy Savings

Albanian's building stock (including residential, public and the private building stock) has a share of around 33-34% of the total primary energy consumption of 2,194 ktoe in 2023 and is the first largest energy consumer with 37.08% followed by the transport sector with 36.56%. The Albanian building stock is split into three main building categories: residential buildings, public buildings and commercial/private service buildings.

Residential buildings in 2023, the total number of residential buildings was calculated to be 632,936 (of which 450,545 or 71.2% are occupied), with a total floor area of approximately 83.52 million m² (of which 56.06 million m² are occupied). By 2050, the total number of residential buildings is estimated to reach around 697,037 (of which 462,605 or 66.4% are occupied) with a total floor area of around 105.64 million m² (of which 94.92 million m² or 89.9% are occupied). This represents an increase of about 10% in the number of buildings and an increase of 26.5% in the total floor area compared to 2023. Table IV-5 shows the number of **all residential buildings (occupied and un-occupied)** and floor area per building type for 2023, 2030, 2040 and 2050.

Table IV-5: Residential buildings (occupied and un-occupied) and floor area per building type

Year	Year 2023 (base year)		Forecast year 2030		Forecast year 2040		Forecast year 2050	
ALL Building's type	No of buildings	Floor area in mio. m²	No of buildings	Floor area in mio. m²	No of buildings	Floor area in mio. m²	No of buildings	Floor area in mio. m²
Detached house	508,643	42.79	531,341	44.70	551,878	46.43	560,156	49.48
Semi-detached house	88,028	7.13	91,881	7.44	95,510	7.74	96,943	8.24
Row or terraced house	15,692	4.37	16,366	4.56	17,026	4.74	17,281	5.05
Apartment building	20,573	29.25	21,513	30.59	22,322	31.74	22,657	42.86
Total	**632,936**	**83.52**	**661,101**	**87.29**	**686,736**	**90.64**	**697,037**	**105.64**

Source: Census 2023, Instat, Consultant's calculations

The table IV-6 shows the number of **occupied** buildings and floor area per building type for 2023, 2030, 2040 and 2050.

Table IV-6: Number of occupied buildings and floor area per building type

Year	Year 2023 (base year)		Forecast year 2030		Forecast year 2040		Forecast year 2050	
Occupied Building's type	No of buildings	No of buildings	No of buildings	Floor area in mio. m²	No of buildings	Floor area in mio. m²	No of buildings	Floor area in mio. m²
Detached house	364,064	28.71	374,631	31.94	385,176	34.86	360,233	44.11
Semi-detached house	63,006	4.79	62,816	5.03	64,359	5.25	66,599	6,19
Row or terraced house	11,013	2.94	10,570	2.97	13,489	3.00	16,782	3.33
Apartment building	12,462	19.63	14,931	24.76	15,264	29.17	18,990	41.29
Total	**450,545**	**56.06**	462,949	64.69	**478,289**	**72.28**	**462,605**	**94.92**

Source: Census 2023, Instat, Consultant's calculations

The table IV-7 shows the number of **un-occupied**[10] buildings and floor area per building type for 2023, 2030, 2040 and 2050.

Table IV-7: Number of un-occupied11 buildings and floor area per building type

Year	Year 2023 (base year)		Forecast year 2030		Forecast year 2030		Forecast year 2050	
Un-occupied Building's type	No of buildings	No of buildings	No of buildings	Floor area in mio. m²	No of buildings	Floor area in mio. m²	No of buildings	Floor area in mio. m²
Detached house	144,579	14.08	156,710	12.76	166,702	11.57	199,923	5.37
Semi-detached house	25,022	2.35	29,065	2.42	31,151	2.49	30,344	2.05
Row or terraced house	4,679	1.44	5,795	1.59	3,537	1.74	499	1.72
Apartment building	8,111	9.63	6,581	5.83	7,058	2.57	3,667	1.57
Total	**182,391**	**27.50**	**198,152**	**22.59**	**208,448**	**18.36**	**234,433**	**10.72**

Source: Census 2023, Instat, Consultant's calculations

Albania's Worst Performing Buildings (WPB): Based on the EPB Law, worst performing residential buildings (WPB) (presented under table IV-8) are defined based on the year of construction. Residential buildings built until 1990 are characterized as worst performing buildings as their energy performance standard can be characterised as poor (no thermal insulation, etc.). Based on this definition, around 299,500 residential buildings or around 66% of the occupied residential buildings can be considered as worst performing buildings in 2023.

Table IV-8: Albania's Worst Performing Buildings

Year	2023	2029	Total until 2050
Total number of occupied buildings	450,545	453,224	462,605
of which: number of WPB	299,500	193,794	0
Total floor area of occupied buildings (million m^2)	56.063	60.121	94.924
of which: floor area of WPB (million m^2)	24.458	15.826	0

Source: Calculation carried out by the EECG consulting team

Public Buildings in 2023, the number of public buildings was calculated to be 9,492 with a total floor area of approximately 6.14 million m². By 2050, the number of public buildings is estimated to reach around 12,950 with a floor area of 9.97 million m². This represents an increase of about 36% in the number of buildings and an increase of 62% in the total floor area compared to 2023. Public buildings are categorized into 5 groups: Municipal education buildings, Municipal administration buildings, Central higher education buildings (University, etc.), Health/Social buildings and Central administration buildings. Table IV-9 shows the number of buildings and floor area per building type for 2023, 2030, 2040 and 2050.

Table IV-9: Central and Municipal Public Buildings

	Year 2023 (base year)	Forecast year 2030	Forecast year 2040	Forecast year 2050

[10] Un-occupied dwellings include newly constructed apartments (but not yet sold), touristically used dwellings and secondary residences.

[11] Un-occupied dwellings include newly constructed apartments (but not yet sold), touristically used dwellings and secondary residences.

Building type	No of buildings	Floor area in mio. m²	No of buildings	Floor area in mio. m²	No of buildings	Floor area in mio m²	No of buildings	Floor area in mio. m²
Municipal schools etc.	3,141	2.22	3,236	2.29	3,463	2.49	4,265	3.56
Municipal Admin	1,323	0.59	1,362	0.61	1,458	0.66	1,795	0.94
Central University	318	0.74	328	0.76	353	0.84	440	1.23
Central Health	2,438	0.54	2,511	0.56	2,689	0.61	3,317	0.89
Central Admin	2,273	2.05	2,345	2.12	2,519	2.31	3,134	3.34
Total	**9,492**	**6.14**	**9,782**	**6.34**	**10,482**	**6.92**	**12,950**	**9.97**

Source: World Bank, Consultant's calculations

Commercial and private service buildings in 2023, the number of commercial/private service buildings was calculated to be 85,098 with a total floor area of approximately 18.96 million m². By 2050, the number of commercial/private service buildings is estimated to reach around 107,481 with a floor area of 35.65 million m². This represents an increase of about 26% in the number of buildings and an increase of around 88% in the total floor area compared to 2023. Commercial and private service buildings are categorized into 6 groups: Wholesale and retail buildings (shops, stores, supermarkets), private offices, private educational buildings, Hotel/restaurant buildings, private health buildings and private culture and sport buildings. The table IV-10 shows the number of buildings and floor area per building type for 2023, 2030, 2040 and 2050.

Table IV-10: Commercial and private service buildings stock

Year	Year 2023 (base year)		Forecast year 2030		Forecast year 2040		Forecast year 2050	
Building Type	No of buildings	Floor area in mio. m²	No of buildings	Floor area in mio. m²	No of buildings	Floor area in mio. m²	No of buildings	Floor area in mio. m²
Wholesale and retail	44,267	5.29	46,957	6.02	51,105	7.23	55,619	8.70
Private office	18,591	1.13	19,490	1.27	20,857	1.50	22,319	1.78
Private Education	1,361	0.75	1,427	0.84	1,527	0.99	1,634	1.17
Hotel, restaurant	17,962	11.04	19,506	13.77	21,956	1.84	24,713	22.92
Private Health	2,389	0.54	2,447	0.59	2,531	0.68	2,618	0.77
Private Culture and Sport	527	0.21	540	0.23	559	0.27	578	0.30
Total	**85,098**	**18.96**	**90,367**	**22.73**	**98,534**	**29.11**	**107,481**	**35.65**

Source: Census 2023, Instat, Strategy of Energy, Consultant's calculations

Defining EE/RE packages for deep renovation and zero-emission buildings. To calculate expected energy and GHG savings for the Albanian building stock two EE/RES packages have been defined:

- Deep Renovation EE/RES package includes the following measures:
  - Thermal insulation of exterior walls
  - Thermal insulation of the roof
  - Thermal insulation of the floor
  - Installation of efficient windows
  - Installation of efficient external doors
  - Efficient heat pump systems
  - Installation of efficient boilers
  - Installation of energy-efficient LED bulbs.

- Zero Emission Building EE/RES package includes the following measures:
in addition to all measures from the deep renovation package the following RE measures is also included:
    - o Installation of a Solar Hot Water System
    - o Installation of a Photovoltaic System
    - o Installation of DH/CHP for high density heat/cool/hot water energy demand for the residential/public buildings/private service and commercial buildings,

EE/RES packages analysed in the industry sector are:

- o Installation of efficient furnaces for meeting higher heat temperature energy demand;
- o Installation of efficient boilers for meeting lower heat temperature energy demand;
- o Efficient heat pump systems for meeting lower heat temperature energy demand;
- o Installation of a Solar Hot Water Systems
- o Installation of a Photovoltaic Systems
- o Installation of DH/CHP for Industrial enterprises.

Albania is committed to aligning its energy and climate policies with the European Union's long-term objectives, including the full decarbonisation of the building sector by 2050. To explore viable pathways toward this goal, three renovation scenarios have been analysed:

- Scenario I – NECP scenario: approx. 29.3% decarbonisation rate in 2050 (this scenario just meets the required GHG emission target of the NECP in 2050: 430 ktCO_2eq)
- Scenario II – Medium decarbonisation: approx. 60% decarbonisation rate in 2050 (this scenario goes beyond the required target of the NECP: 388.22 kt CO_2eq in 2050)
- **Scenario III – Full decarbonisation: fully 100% decarbonised building stock in 2050** (this scenario meets the requirements of the EPB Law and Albania's long-term obligations: 351.93 kt CO_2eq in 2050).

Residential building sector **final energy targets** to achieve a fully decarbonized building stock by 2050 (Scenario III): In the base year 2023, the final energy demand of the residential building stock was 504.14 ktoe based on the Energy Balance of 2023. By 2050, the final energy demand is expected to decrease to 447.84 ktoe, representing a decrease of about 11.2% compared to 2023. In comparison, the final energy demand of the NECP scenario is equal to 483,4 ktoe in 2050.

Public building sector **final energy targets** to achieve a fully decarbonized building stock by 2050 (Scenario III): In the base year 2023, the final energy demand of the public building stock was calculated to be 43.95 ktoe based on the Energy Balance of 2023. By 2050, the final energy demand is expected to increase to 65.22 ktoe, representing an increase of about 48.4% compared to 2023. In comparison, the final energy demand of the NECP scenario is equal to 68.01 ktoe in 2050.

Commercial and private sector buildings **final energy targets** to achieve a fully decarbonized building stock by 2050 (Scenario III): In the base year 2023, the final energy demand of the commercial and private sector building stock was calculated to be 180.78 ktoe based on the Energy Balance of 2023. By 2050, the final energy demand is expected to increase to 271.22 ktoe, representing a decrease of about 50.0% compared to 2023. In comparison, the final energy demand of the NECP scenario is equal to 282.87 ktoe in 2050. Table IV-11 presents overview of the targeted final energy demand [ktoe] for the Albanian Building Stock for 2030, 2040 and 2050.

Table IV-11: Final Energy Demand Scenario for Building Stock

Building type	Base year 2023 (ktoe)	2030 (ktoe)	change 2030 vs 2023 (ktoe)	2040 (ktoe)	change 2040 vs 2023 (ktoe)	2050 (ktoe)	change 2050 vs 2023 (ktoe)
Residential Buildings	504.14	453.72	-10.0%	397.55	-21.2%	447.84	-11.15%
Public Buildings	43.95	49.68	+13.1%	57.49	+30.8%	65.22	+48.4%

Commercial/private service buildings	180.78	209.00	+15.6%	242.04	+33.9%	271.22	+50.0%
Total	**728.87**	**712.39**	**-2.3%**	**697.08**	**-4.4%**	**784.28**	**+7.6%**

Source: Consultant's calculation

<u>Albania's building stock: accumulated no of buildings and floor area to be renovated to achieve the GHG emission targets in 2030, 2040 and 2050:</u>

To meet the targets of the full decarbonization scenario, around 74,328 buildings have to be renovated or constructed as ZEB by 2030, 315,783 buildings by 2040 and 583,036 buildings by 2050. In total, 583,036 buildings (approx. 140 mio. m² of floor area) have to be renovated or constructed as ZEB until 2050. It is considered that from 2028 (public buildings) and 2030 (all other buildings) onwards all newly constructed buildings will be constructed as Zero Emission Buildings (ZEB). Overview of number of buildings to be renovated or constructed as ZEB for 2030, 2040 and 2050 (table IV-12).

Table IV-12: Overview of number of buildings to be renovated or constructed as ZEB

Building type	2030		2040		2050	
	No	mio m²	No	mio m²	No	mio m²
Residential Buildings	49,443	8.23	242,228	43.60	462,605	94.92
Public Buildings	2,432	1.64	7,763	5.26	12,950	9.97
Commercial/private service buildings	22,453	5.83	65,792	18.29	107,481	35.65
Total	**74,328**	**15.70**	**315,783**	**67.15**	**583,036**	**140.54**

Source: Consultant's calculation

Figures IV-2 - IV-3 are presenting the final energy savings for each sector and total one and at the same time meeting the energy demand for heating, cooling and hot water. The figure below illustrates also penetration of DH/CHP in all four sectors for the period 2023-2050.

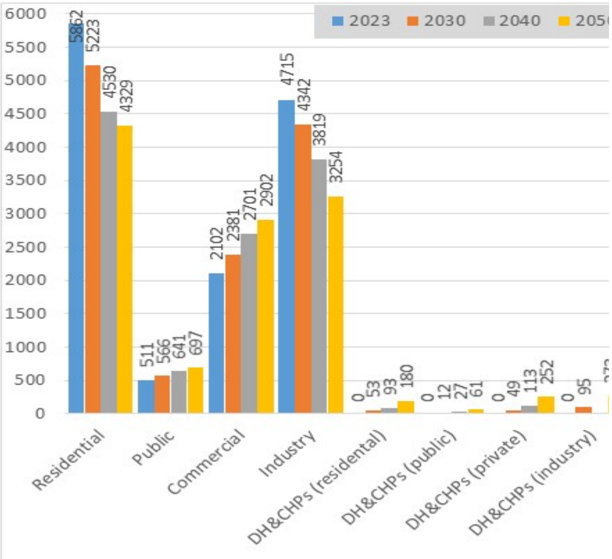


Figure IV-2: Final energy demand scenario for each sector according to the full decarbonisation scenario (GWh)

Source: Consultant's calculation

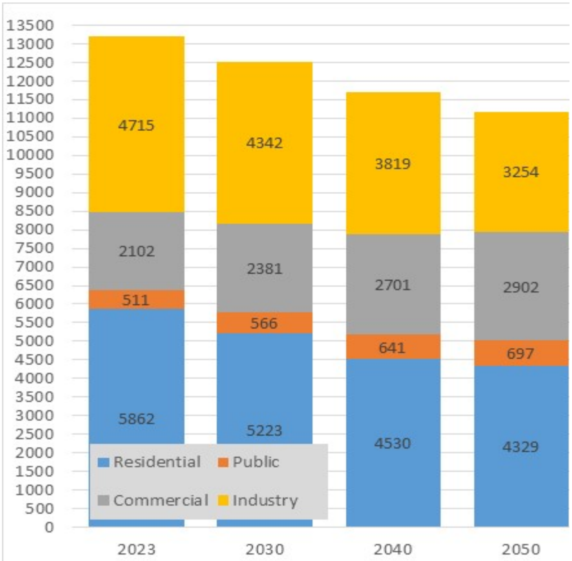


Figure IV-3: Final energy demand scenario for each sector according to the full decarbonisation scenario (GWh)

Source: Consultant's calculation

IV.7 Primary Energy Savings

Primary energy supply factors used in Albania are based on the Energy Balance for the year 2023 and presented in the Table IV-13.

Table IV-13: Primary energy supply factors for Albania

Primary Energy Sources	Solid fuels	Natural Gas	Crude oil and net imported oil by products	Biomass (Fuelwood)	Hydro & Net Imported Electricity	Solar Energy	Derived Heat
Primary Energy Sources, ktoe	175.60	4.41	1149.66	139.20	695.41	35.14	6.39
Final Energy Consumption, ktoe	130.1	4.2	1057.7	139.20	558.52	35.14	4.7
Primary Energy Supply factors	1.350	1.052	1.087	1.000	1.245	1.000	1.360

Source: Prepared by the Consultant based on Albanian Energy Balance 2023, INSTAT, MIE/AKBN

Albania has a very low weighted average primary energy supply factor equal to 1.13 (due to RES contribution equal to 43.41%, as supply comes almost entirely from electricity generation by hydro and solar plants; Moreover, very few small district heating systems that exists are based on pellets/biomass and solar hot water system), compared with most of the Western Balkan Countries, which have a primary factor higher than 1.75.

Figures IV-4 – IV-5 are presenting the final energy savings for each sector and total one and at the same time meeting the energy demand for heating, cooling and hot water. The following figures illustrate also the penetration of DH/CHP in all four sectors for the period 2023-2050 and more details will be presented at the session IV.9.

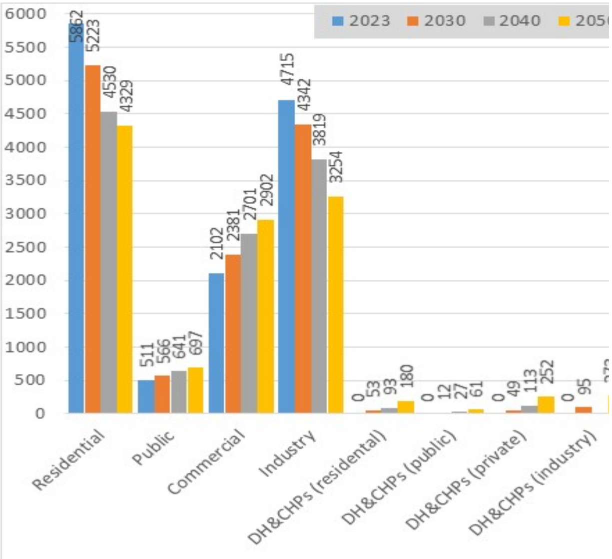


Figure IV-4: Final energy demand scenario for each sector according to the full decarbonisation scenario (GWh)

Source: Consultant's calculation

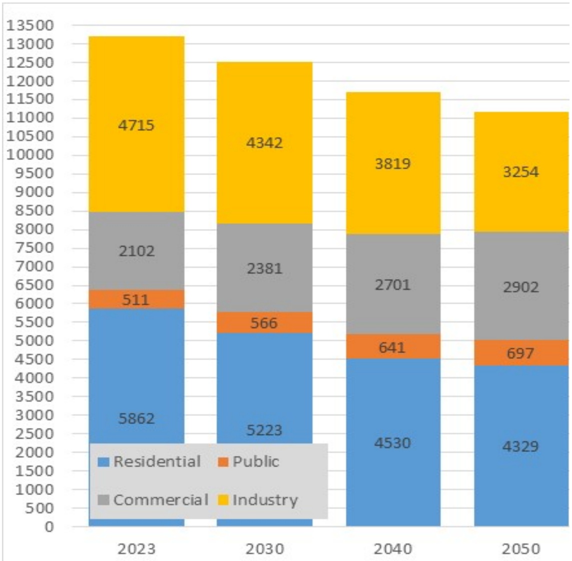


Figure IV-5: Final energy demand scenario for each sector according to the full decarbonisation scenario (GWh)

Source: Consultant's calculation

IV.8 Greenhouse Gas Emission Reductions

In order to meet Albania's long-term obligations and align with the objective of achieving a fully decarbonised building stock by 2050, **Scenario III has been selected as the reference scenario.** It serves as the analytical foundation for the Building Renovation Plan, detailing the strategic, technical, and financial measures required to reach this target.

Scenario III is not only fully aligned with Albania's National Energy and Climate Plan (NECP), but also goes beyond its ambitions, meeting the requirements set forth in the draft Law on the Energy Performance of Buildings (EPB Law).

Residential building sector **GHG emission targets** to achieve a fully decarbonized building stock by 2050 (Scenario III): In the base year 2023, the GHG emissions of the residential building stock were calculated to be 337.5 kt CO_2eq. By 2050, the emissions are expected to decrease to 57.3 kt CO_2eq, representing a decrease of about 83.02% compared to 2023. In comparison, the GHG emissions of the NECP scenario is equal to 123.40 kt CO_2eq in 2050.

In regard to worst performing buildings (WPB), it is envisaged to prioritizing the renovation of worst-performing buildings resulting in a gradual phasing out by 2039.

Public building sector **GHG emission targets** to achieve a fully decarbonized building stock by 2050 (Scenario III): In the base year 2023, the GHG emissions of the public building stock were calculated to be 42.97 kt CO_2eq. By 2050, the emissions are expected to increase with at a moderate rate to 54.88 kt CO_2eq, representing an increase of about 27.63% compared to 2023. In comparison, the GHG emissions of the NECP scenario is equal to 59.96 kt CO_2eq in 2050.

Commercial and private sector buildings **GHG emission targets** to achieve a fully decarbonized building stock by 2050 (Scenario III): In the base year 2023, the GHG emissions of the commercial and private sector building stock were calculated to be 176.73 kt CO_2eq. By 2050, the emissions are expected to increase to 239.75 kt CO_2eq, representing an increase of about 35.67% compared to 2023. In comparison, the GHG emissions of the NECP scenario is equal to 277.65 kt CO_2eq in 2050. Table IV-14 presents overview of the targeted GHG emissions [kt CO_2eq] for the Albanian Building Stock for 2023, 2030, 2040 and 2050.

Table IV-14: Overview of the targeted GHG emissions [kt CO2eq] for the Albanian Building Stock

Building type	Base year 2023 (kt CO_2eq)	2030 (kt CO_2eq)	change 2030 vs 2023 (kt CO_2eq)	2040 (kt CO_2eq)	change 2040 vs 2023 (kt CO_2eq)	2050 (kt CO_2eq)	change 2050 vs 2023 (kt CO_2eq)
Residential Buildings	337.5	249.83	-26.0%	127.10	-62.3%	57.30	-83.0%
Public Buildings	42.97	45.20	+5.1%	48.27	+1.3%	54.88	+27.6%
Commercial/private service buildings	176.73	192.07	+8.7%	217.26	+22.9%	239.75	+35.7%
Total	**557.2**	**487.1**	**-12.6%**	**392.63**	**-29.5%**	**351.93**	**-36.8%**

Source: Consultant's calculation

Figures IV-6 – IV-9 shows the GHG emission targets of the full decarbonisation scenario for all sectors analysed (residental, public buildings, private service and commercial buildings and industry) versus the NECP scenario for 2030, 2040 and 2050. In 2030, the GHG emissions of the full decarbonisation scenario is 9.5%, in 2040 23.2% and in 2050 of 30.7% below the GHG emission targets of the NECP scenario. The GHG emission target of the NECP is 645 ktCO_2eq in 2050, while the target of the full decarbonisation scenario is 605 ktCO_2eq.

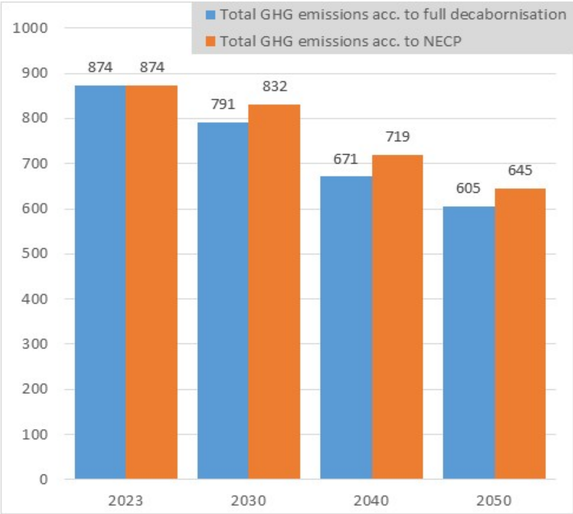


Figure IV-6: GHG emission targets of the full decarbonisation scenario for all sectors analysed versus the NECP (kton)
Source: Consultant's calculation

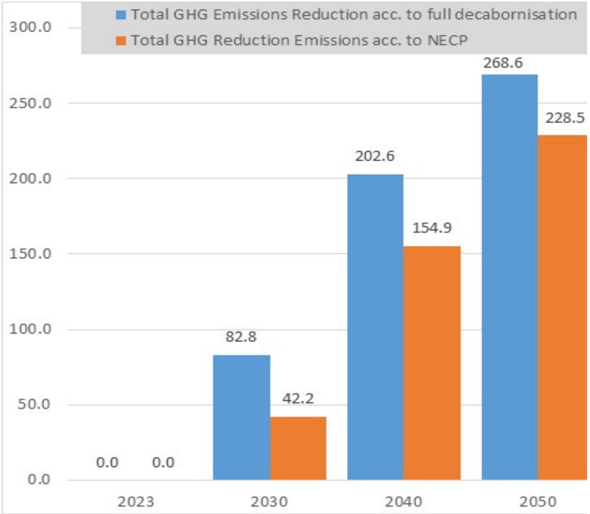


Figure IV-7: GHG emission reduction targets of the full decarbonisation scenario for all sectors analysed versus the NECP (kton)
Source: Consultant's calculation

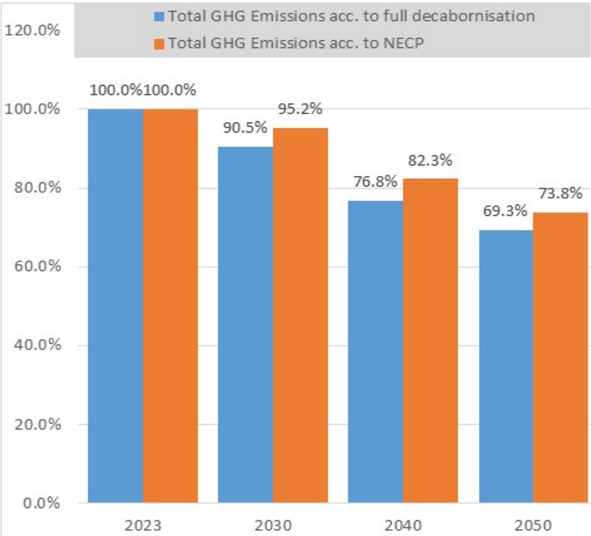


Figure IV-8: GHG emission targets of the full decarbonisation scenario for all sectors analysed versus the NECP(in % versus 2023)
Source: Consultant's calculation

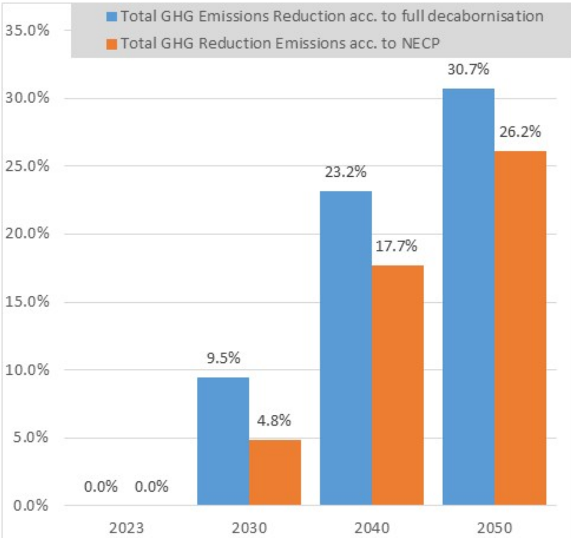


Figure IV-9: GHG emission targets of the full decarbonisation scenario versus for all sectors analysed the NECP (in % versus 2023)
Source: Consultant's calculation

Figures IV-10 - IV-11 illustrates the greenhouse gas (GHG) emission targets within the full decarbonisation scenario for each sector by the years 2030, 2040, and 2050. Under this scenario, GHG emissions are anticipated to decrease by 12.6% in 2030, 29.5% in 2040, and 36.8% in 2050 relative to the base year of 2023. Specifically, the residential sector is projected to achieve the largest share reduction in emissions by 2050 compared to 2023. Conversely, the public and commercial sectors are expected to experience increases in emissions of 27.6% and 35.7%. The rise in GHG emissions within the public and commercial building sectors is primarily attributed to the expansion of conditioned floor areas and an increased specific energy demand, particularly within the tourism industry. However, growth rate of final energy demand, primary energy demand and GHG emission will be with much lower growth rate versus baseline scenario.

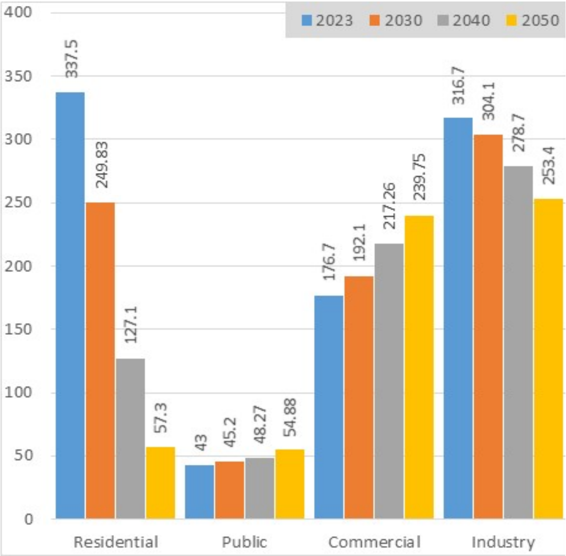


Figure IV-10: GHG emission targets for each sector according to the full decarbonisation scenario (kton)

Source: Consultant's calculation

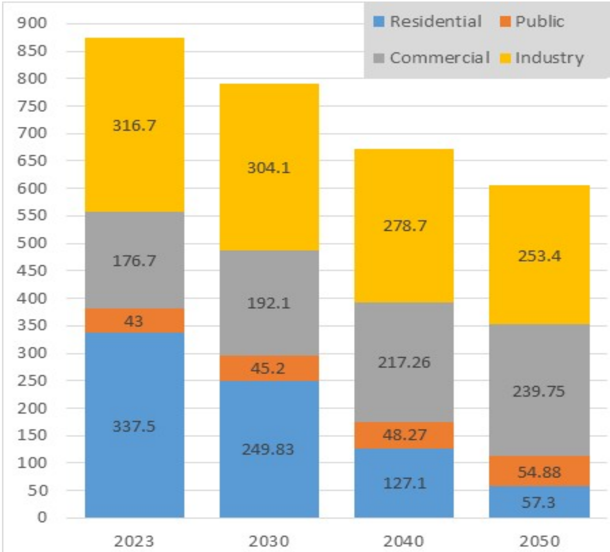


Figure IV-11: GHG emission targets for each sector according to the full decarbonisation scenario (kton)

Source: Consultant's calculation

IV.9 Impact on the Share of High-efficiency Cogeneration

During the period 1960-1980, Combine Heat and Power Plants (CHP) in Albania has been more developed than Heat only Boilers (HOB), which from their side are used only in hospitals, Student City, industry, institutional buildings and in any other small place. CHP, instead of HOB, has played an important role in supplying technological process heat to industrial customers.

The first thermal power plants installed in the early mid 1950s at Maliq, Kucova, Vlora, and Cerrik, had capacities smaller than 10 MW, and were coal fired thermal power plants. All of the nine thermal power plants installed in Albania produce both heat and power. Four of them, such as Ballshi, Kucova, Cerrik, and Maliq, are dedicated plants providing heat only to the respective refineries, and the other five were planned to provide electricity and heat to a variety of end users. During the 1990s, heat distribution to industrial customers is severely reduced due to low industrial demands. However, many of the older plants have very degraded heat distribution systems, which have not allowed their full capacity. So almost all of them are stopped at the end 2000.

District Heating may be defined as the supply of the space heating and hot water to a number of buildings from a central heating plant or a group of heating plants, which are link to each other. In many cases some of them may be a Combined Heat and Power Plants. The heat produced in this plant is delivered to the consumers as hot water or steam through an insulated, double pipe line system. The heated water is carried in the supply pipeline. After giving up its heat, the cooler water returns to the plant for reheating. As it is known, the district heating systems may vary in size from those serving a small group of houses to those covering a whole metropolitan area.

District Heating gives to the consumer a comfortable and reliable supply. It is easy to use, can't be seen, heard or even smelled. The absence of individual smoke stacks makes it an environmentally sound heating solution. It has a long tradition in many countries dating back to the early decades to previous century. The extent and branching of the system are determined according to the location of the heating plants, the location of consumers, the possibility of the practical placement of the pipes, and a financial evaluation that takes into consideration the heat loss from the pipeline. The larger district heating connection over a given are, the better efficiency. In order to ensure a sufficient supply temperature, the flow and return piping are sometimes "short-circuited" by means of bypasses. Often one distinguishes between the following types of district heating pipes:

- ***Transmission pipes*** leading heat from large heating production plants (e.g., heat and power stations) to one or more local distribution networks, where the heat is transported further on, first passing a heat exchanger.
- ***Main pipes*** leading heat from a heat exchanger/district heating station to the service pipes. The main pipes normally follow streets and roads.

- ***Service or branch pipes*** leading heat from the main pipes to individual consumers.

The construction of District Heating Systems requires large investments in capital-intensive installations, not only in productions units built in well-insulated long transmission lines. The economic consequences for the companies and consumers that follow the introduction of a new DH project, a systematic analysis of the socio-economic consequences is necessary for a complete evaluation of the project. A DH system influences many aspects of society such as:

7. Rational use of energy,
8. Environment,
9. Balance of payments,
10. Production facilities,
11. Employments and demographic development,
12. Health and Education.

Stability of the future heating costs is an important factor for the consumers of district heating. Economic calculations to justify CHP & DH schemes are carried out at various levels. The most favourable conditions for financing new District Heating Schemes are found in utilities which gradually been built up over many years. The more rapidly that consumers can be connected to the heating network, the better will be the economy of the operation. Compulsory connections to existing collective systems are often enforced in new building areas. The consumer economy differs from that of the utilities and District Heating Companies. In principles, the DH companies compete in the market and balance the tariffs against competitors such as oil and gas based central heating systems, but the market economy is modified by such energy policy measures as taxation, subsidies, and regulations, including laws relating to the heat supply. As was also presented above, no DH/CHP system is foreseen in the base scenario. Meanwhile, in the second scenario of efficient and RES heating and cooling supply scenario with much higher penetration compared with NECP-WAM (With Additional Measures) by introducing more efficient and renewable heating and cooling technologies, distinguishing between energy derived from fossil and renewable sources where applicable DH/CHP supply schemes will occupy an important place in meeting the needs for heating, cooling and hot water for all four residential, public, private service and commercial buildings as well as industry sectors.

CHP, cogen or co-generation is defined as simultaneous production of electricity and heat from the same fuel. The phrase “total energy” has been used to describe a range of applications from, for example, an industrial gas turbine using the exhaust gas to raise steam, to much more complex plants involving a large number of processes. There are many definitions of total energy schemes, but one of them may be: *A scheme in which the total energy requirements of a plant in the form of power and heat are provided from a supply of primary fuel*.

The definition of total energy given above covers the use of refrigeration, heat pumps, recovery of energy from waste water and waste gases etc., as well as the use of boilers and all types of prime movers used either for electricity generation or for direct mechanical drives. More restricted schemes, which combine electricity generation with heat for ensuring space heating and/or specific industrial processes, are frequently referred to as Combined Heat and Power (CHP) or cogeneration. Schemes in which thermal energy is produced centrally and distributed through (via) pipe networks for the heating of houses and public buildings, such as the Student City, are referred as District Heating Schemes (DH). CHP schemes can incorporate district heating. There are three main types of prime movers used as CHP plants: gas turbines, internal combustion engines and steam turbines.

Gas Turbines. They have captured the largest share of the recent cogeneration market. Typical gas turbines applications range from a few hundred kW to 500 MW. Nowadays, combustion turbines are commercially available in packages ranging from 200 kW to more than 150,000 kW. Those plants have been applied to both base load and peaking application, and provide a number of benefits, including relatively small size, high temperature recoverable heat, high reliability and availability, and relatively low-cost maintenance. Much of their success in the cogeneration industry is a result of low initial costs, high availabilities, excellent and low-cost maintenance characteristics, fuel-switching capabilities, high-quality heat that can be simply recovered, and high efficiencies in large sizes.

Gas turbines concepts are simple as compared to other technologies. The simplest open-cycle system operation consists of three major components and operates through a Brayton cycle. Gas turbine cogeneration plants are becoming more popular part, particularly of their optimum heat/power ratio of around 3:1. The CHP plant can now be run with the philosophy of matching the demand for heat, and exporting excess power to help with economics of the plant. This concept will be also used at the Student Cities, large central and regional hospital around Albania. This scheme can be used for large hotel areas for tourism by introducing three-generation (heating-cooling-power) as well as industrial parks. A prime mover (motor) as it is gas turbine with a lower heat/power ratio will help in this concept. A gas turbine used for CHP would normally be fuelled by natural gas or biogas as well as biomasses.

Internal Combustion Engines. All internal combustion engines operate in the same way when acting as CHP units; power is used to drive a generator and heat is recovered from the engine exhaust, jacket water and lubricating oil. The size range is enormous: from the 15-kW diesel/natural gas unit for the use in the domestic/service consumers to 50 MW diesel units (or some time heavy fuel oil) for use in the industrial sector. The largest diesel units operate at heat/power ratios of around 1:1 whereas some other units can operate efficiently around 2:1. Additionally, reciprocating engines are extremely efficient in small sizes, and are available over a broad range of sizes ranging from tens of kW to 50 MW, can be fired on a broad variety of fuels and have excellent availability. As a result, they have been used in a numerous cogeneration system serving residential, commercial, service, institutional and small industrial loads.

Steam Turbine. Steam-turbine-based power generation cycles have been the workhouse of the power generation industry. They are available in a broad range of sizes from a few hundred kW to more than 1000 MW. After many decades of focusing primarily on increasing system size, the turbine industry has recently turned towards increasing efficiency and availability. Because of their energy characteristics and the need to operate the steaming portion of the cycle, steam-turbine based systems have been used primarily for base load applications, with older plants being relegated to intermediate duty. Finally, because of the availability to extract steam at various ports throughout the expansion process, they allow for greater flexibility in matching cycle thermal capabilities with loads.

The typical steam-turbine-based system consists of several major components: a heat source, a steam power turbine and a heat sink. A second major component is a heat sink. In as much as the turbine operates by allowing the steam to expand, giving up energy and doing work, the cycle must include a mechanism for rejecting the steam, and the energy therein that is exhausted from turbine. This heat sink can be a thermal process, as is the case with cogeneration systems, or it can be the environment.

Steam turbine technology is quite diverse, operating over a broad range of steam conditions and design concepts. As described below, steam turbines can be categorized in a number of ways, including the process by which steam expands and does the work, the manner in which steam exists the turbine, and the manner in concept: as steam expands while flowing through a nozzle, it accelerates and forms a high-speed-jet. The kinetic energy of the jet is then transferred to a series of rotating blades that produce mechanical work. Cogeneration cycles can be categorised according to the sequence in which the power and thermal energy are produced. The typical topping cycle cogeneration system produce firstly electricity and after that fuel gases are used to produce heat as by-product. This is based on a gas combustion turbine; however, reciprocating engines and steam turbines are also consistent with topping cycle cogeneration. The turbine drives a generator while the exhaust gases, which are generally in excess of 400-500 ºC, are routed to a heat recovery steam generator (HRSG), where they are used to produce steam. In some cases, the exhaust gases can be used directly, eliminating the need for a HRSG. A bottoming cycle cogeneration system is one in which the fuel is first used for some thermal processes, with the exhaust gases being the by-product that is used to produce power. Most cogeneration systems utilize a topping cycle.

The basic argument in favour of a CHP is that it should be possible to obtain a worthwhile overall advantage by local generation of electricity, and at the same time make used of about two-thirds of the waste heat. Other specific benefits can be detailed as follows:

9. **Improved Albanian National Energy Efficiency and Preservation of Fossil Fuels Reserves (non-renewable energy).** The integrated schemes of solar panels (for hot water) with central and district heating and the CHP schemes are feasible from the energy efficiency and economical point of view.

10. **Local Generation of Electricity.** This will reduce the technical losses on transmission and distribution networks. This is with particularly interest for Albania since the losses in the transmission & distribution system are far too high at 1,230 GWh or 18% of the net supply

entering the system in 2024. These losses could be reduced by 50 % by rehabilitation and locally generation of electricity, which will increase the capacity of the system.

11. **Reduction in Environmental Pollution.** A reduction in the amount of pollution follows from the more efficient conversion of less fuel. In almost all the Western European Countries, most construction permits for medium and large cogeneration projects of a 5 MW or more will include a requirement for continuous emission monitoring for SO_2, NO_x and CO. In addition, air quality decreases, the amount and cost of the offsets required for permitting will increase.

12. **Investment in Industry (more jobs) and Service Sector:** Different strategies in different countries (Denmark, Holland, etc) has shown that by introducing CHP and District Heating (as well as Central Heating) more jobs will be created in the engineering, construction and service industries in municipal levels as well as in small service sector.

CHP is such an attractive proposition thermodynamically that many wonders why it is not used more widely in industrial, service and blocks of multi-storey buildings. As we will analyse in many Albanian case studies carried out by the consultant, the reasons are largely economic and relate to financial evaluation of capital investment. Detailed arguments are as follows:

- If an industry decided to invest in CHP plant, then it is committed to a course of action and expenditure for a number of years. The financial appraisal of such a project involves a number of assumptions on the future energy demands of company, fuel prices and availability, taxes, discount rates, maintenance costs, which may be accurate only in the short term. It may be safer for a consumer simply to purchase the electricity from national grid and generate heat from its own boiler than to generate both of them from a CHP. This is one of the reasons that we have taken under consideration in our option for supply electricity and heat to Student City.
- Any change in consumer behaviour may result in a later demand for more heat or power required more plant at a cost much higher than initial installation.
- Any change in consumer behaviour may result in a change in the balance of demand for heat and power. This point is covered in more details when will be analysed each option, but now we might say that will alter the overall efficiency of the plant and hence its economic viability.
- Any CHP plant design will include a provision for back-up, to ensure security of supply heat and electricity. Any support plant can only be regarded as spare capacity, which, by definition, will not be frequently used, and therefore will not be generating sufficient savings to offset the initial capital costs. Failure to include a back-up system, especially for a consumer as Student City, is an unacceptable risk.
- Apart from the capital costs of the prime power motor, there are large costs associated with the distribution of heat in pipelines. These costs may be a significant part of the initial investment unless the heat user is relatively near prime mover motor.
- Electricity demand and thermal energy demand are not at the same time, so it is very important to add a storage tank for thermal energy. This will increase first investment of energy supply scheme.

Figure IV-12 illustrates forecasted installed heating/cooling capacity of DH/CHP, for the period 2023-2050, for all four residential, public, private service and commercial buildings as well as industry sectors. In addition, it is very important to be mentioned that the following analysis refers specifically to high-efficiency cogeneration as defined under the Energy Efficiency Directive. Also, all cogeneration units selected are meeting the high-efficiency criteria. Analysis shows clearly that installed capacity of high-efficiency DH/CHP will reach 518 MW and the highest share belong to industry and commercial (new tourism resorts). Figure IV-13 illustrates forecasted heating/cooling/ power generation of high-efficiency DH/CHP, for the period 2023-2050, for all four residential, public, private service and commercial buildings as well as industry sectors.

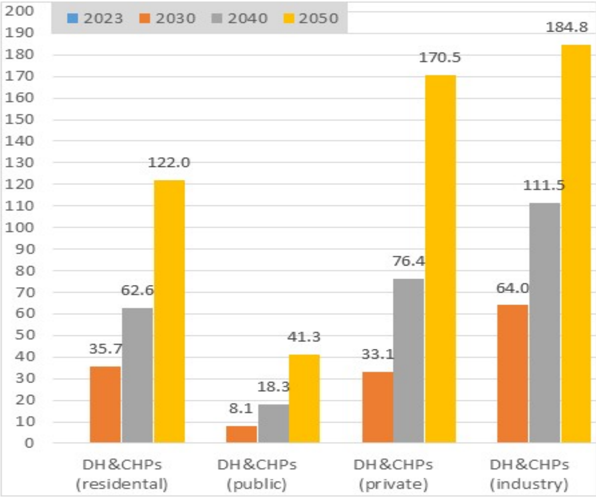


Figure IV-12: Forecasted installed heating/cooling capacity of high-efficiency DH/CHP for each sector according to the full decarbonisation scenario (MW)

Source: Consultant's calculation

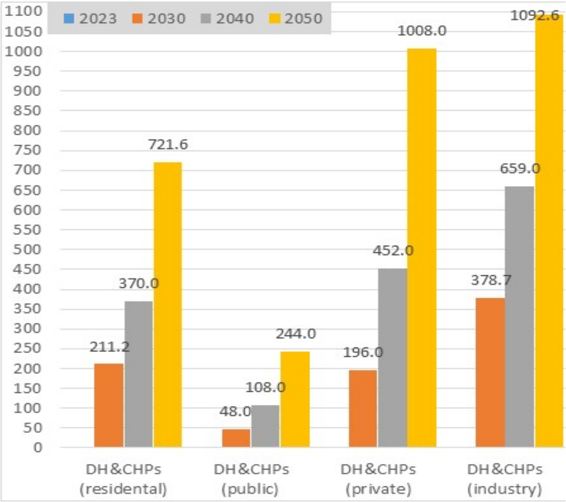


Figure IV-13: Forecasted heating/cooling/electricity generation of high-efficiency DH/CHP for each sector acc. to the full decarbonisation (GWh)

Source: Consultant's calculation

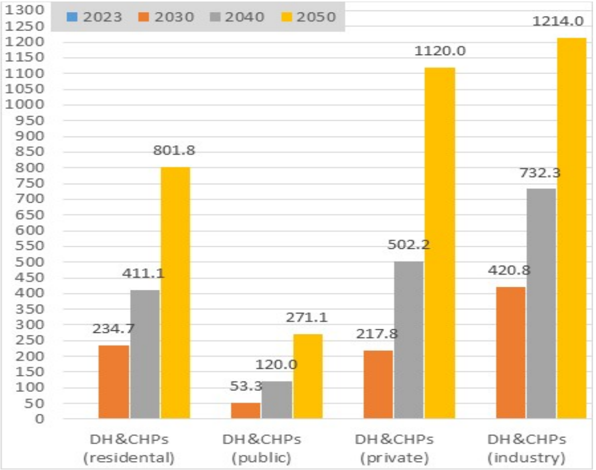


Figure IV-14: Forecasted the final energy commodities to be used by the high-efficiency DH/CHP for each sector according to the full decarbonisation scenario (GWh)

Source: Consultant's calculation

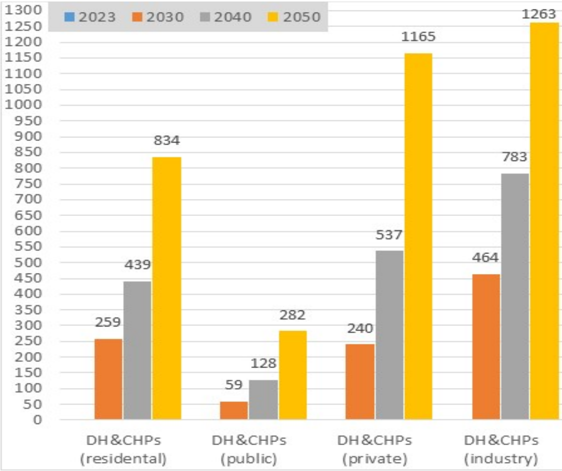


Figure IV-15: Forecasted primary energy sources to be used by high-efficiency DH/CHP for each sector according to the full decarbonisation scenario (GWh)

Source: Consultant's calculation

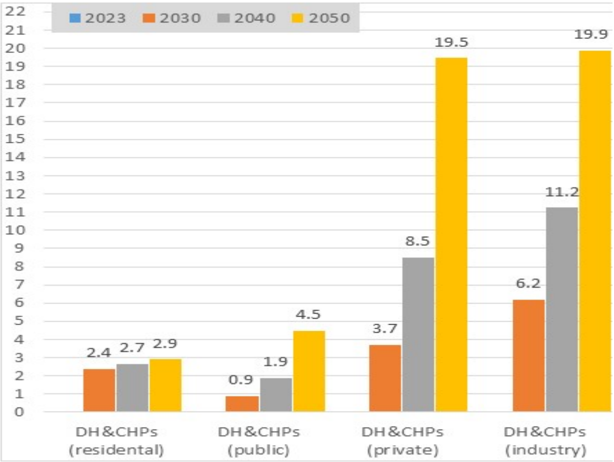


Figure IV-16: Forecasted GHG reduction of high-efficiency DH/CHP for each sector according to the full decarbonisation (kton)

Source: Consultant's calculation

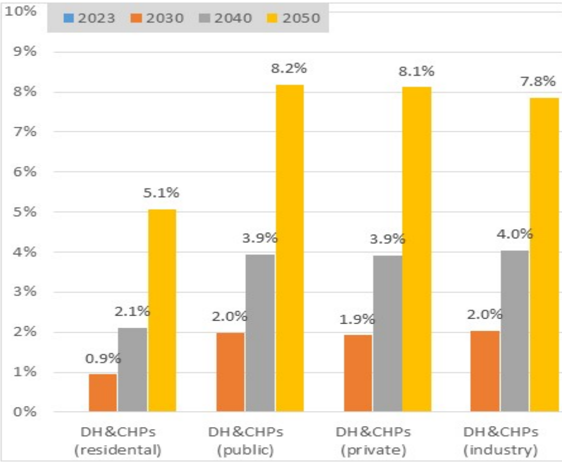


Figure IV-17: Forecasted GHG reduction of high-efficiency DH/CHP according to the full decarbonisation scenario (% vs total)

Source: Consultant's calculation

Figures IV-14 – IV-15 are presenting forecasted the final and primary energy commodities to be used by the high-efficiency DH/CHP for each sector according to the full decarbonisation scenario. It is very important to be mentioned that all new DH/CHP plants (for the respective sectors) will be design to be based in sustainable biomass sources and natural gas will serve as back-up energy source.

Meanwhile, figures IV-16 – IV-17 are presenting forecasted the final and primary energy commodities to be used by the high-efficiency DH/CHP for each sector according to the full decarbonisation scenario. It is very important to be mentioned that all new DH/CHP plants (for the respective sectors) will be design to be based in sustainable biomass sources and natural gas will serve as back-up energy source.

IV.10 Impact on the Share of RES in the National Energy Mix and in the Heating and Cooling Sectors

Figure IV-18 - IV-19 illustrates forecasted RES contribution (GWh) for meeting heating/cooling/DHW (Domestic Hot Water) for the residential sector, for the period 2023-2050, for the residential sector. Analysis shows clearly that RES contributions have the potential to be increase their contribution from 57.4% (2023) up to 74.98% (2050) and all RES measures selected are cost optimal and financially feasible.

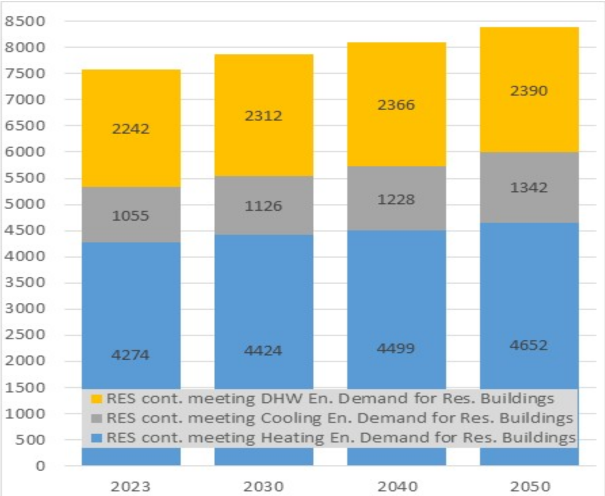


Figure IV-18: RES contribution (GWh) for meeting heating/cooling/DHW for the residential sector

Source: Consultant's calculation

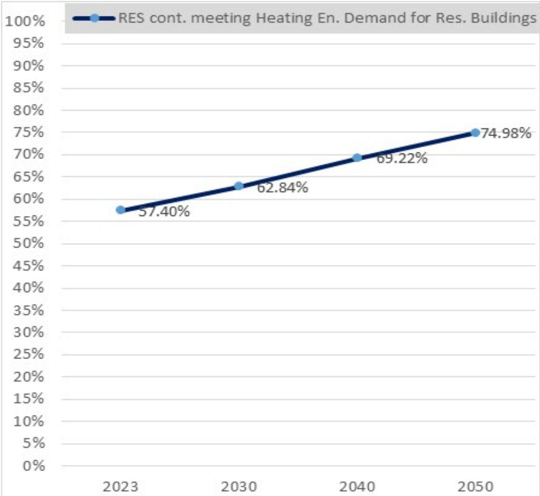


Figure IV-19: RES share contribution versus total energy demand for the residential sector

Source: Consultant's calculation

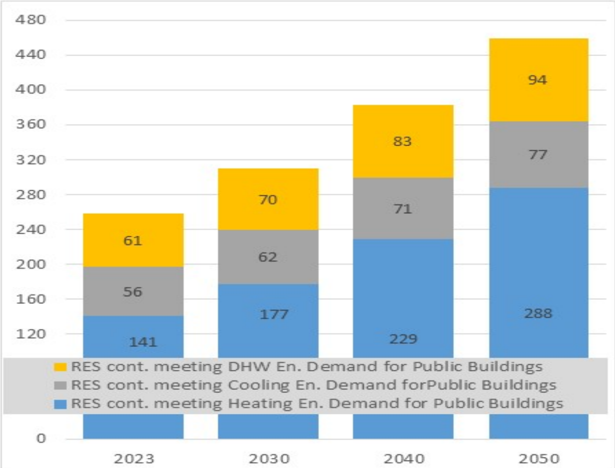


Figure IV-20: RES contribution (GWh) for meeting heating/cooling/DHW for the public sector

Source: Consultant's calculation

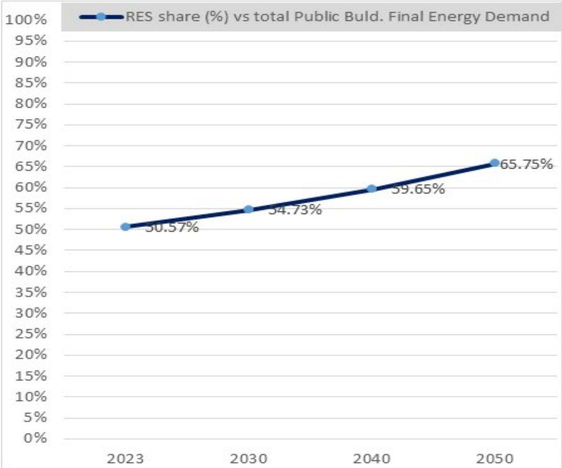


Figure IV-21: RES share contribution versus total energy demand for the public sector

Source: Consultant's calculation

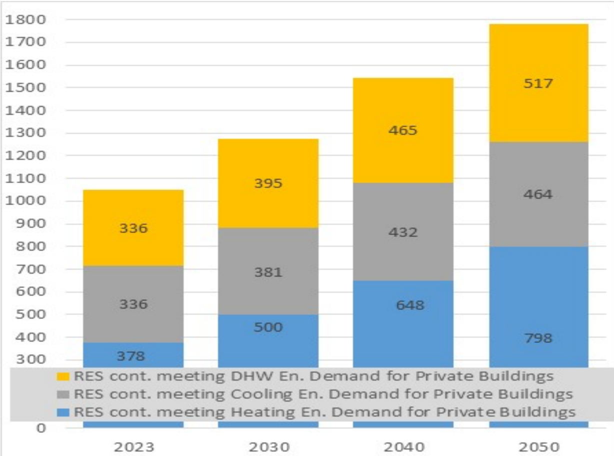


Figure IV-22: RES contribution (GWh) for meeting heating/cooling/DHW for the private sector

Source: Consultant's calculation

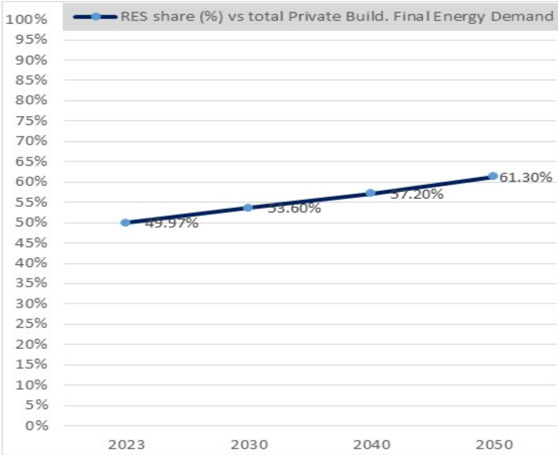


Figure IV-23: RES share contribution versus total energy demand for the private sector

Source: Consultant's calculation

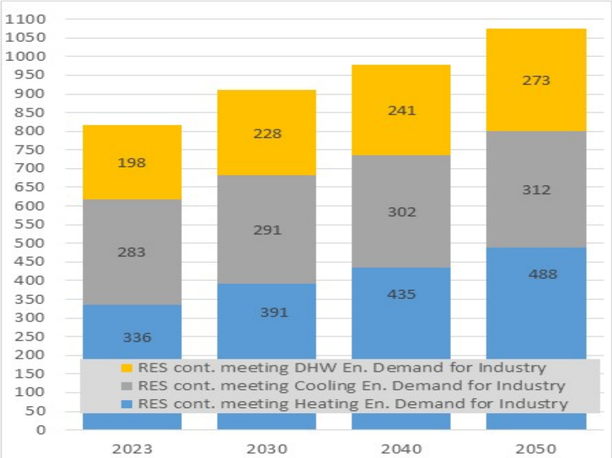


Figure IV-24: RES contribution (GWh) for meeting heating/cooling/DHW for the industry sector

Source: Consultant's calculation

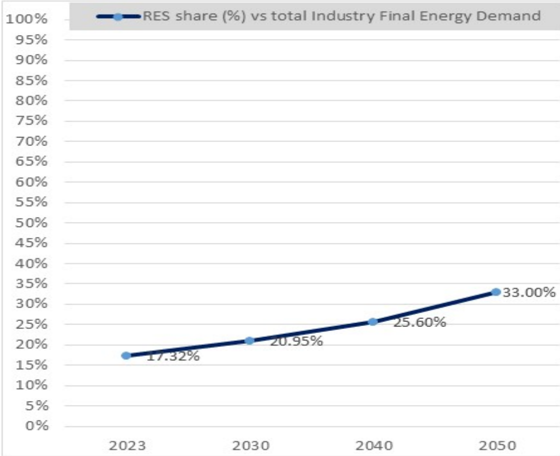


Figure IV-25: RES share contribution versus total energy demand for the industry sector

Source: Consultant's calculation

Figure IV-20 – IV-21 illustrates forecasted RES contribution (GWh) for meeting heating/cooling/DHW for the central and municipal public buildings sector and analysis shows clearly that RES contributions have the potential to be increase from 50% (2023) up to 65% (2050) and all RES measures selected are cost optimal and financially feasible.

Figure IV-22 – IV-23 illustrates forecasted RES contribution (GWh) for meeting heating/cooling/DHW for the private service and commercial building sector and analysis shows clearly that RES contributions have the potential to be increase their contribution from 49% (2023) up to 61% (2050) and all RES measures selected are cost optimal and financially feasible.

Figure IV-24 – IV-25 illustrates forecasted RES contribution (GWh) for meeting heating/cooling/DHW for the industry sector and analysis shows that RES contributions have the potential to be increase from 17% (2023) up to 33% (2050) and all RES measures selected are cost optimal and financially feasible.

Figure IV- 26 – IV-27 illustrates forecasted RES contribution (GWh) for meeting heating/cooling/DHW for the all four above mentioned sectors and analysis shows that RES contribution will be increased from 45% (2023) up to 70% (2050) for meeting space heating, cooling and hot water energy demand.

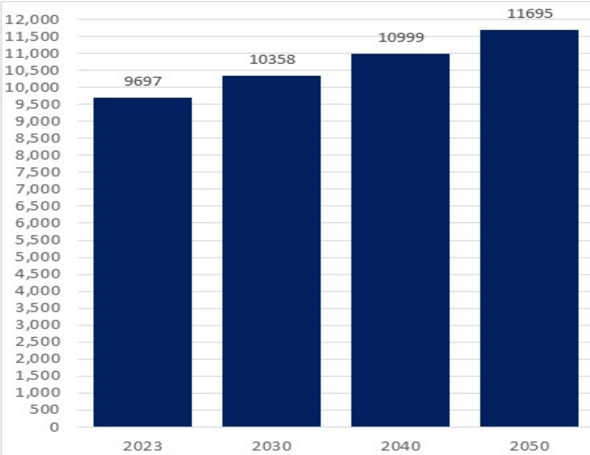


Figure IV-26: RES contribution (GWh) for meeting heating/cooling/DHW for all sectors
Source: Consultant's calculation

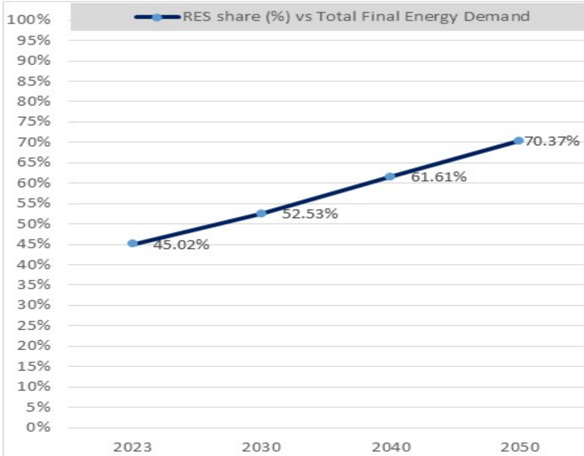


Figure IV-27: RES share contribution versus total energy demand for all four sectors
Source: Consultant's calculation

IV.11 Links to National Financial Programming and Cost Savings for the Public Budget and Market Participants

Analysis of all EE/RES measures for meeting heating/cooling/hot water energy demand for the residential, public, private and industry sectors shows that the overall energy savings potential of 35-50% compared to the baseline energy demand and 15% further reduction compare with WAM scenario of NECP. The monetary value of these energy savings (at actual prices) is presented in Table IV-15.

Table IV-15: Monetary value of energy savings

Main parameters	I. Residential Buildings	II. Public Service Buildings	III. Private & Commercial Service Buildings	IV. Industrial Enterprises	TOTAL Four Sectors
Energy consumption (ktoe)	854	157	340	406	1,757
Energy expenditures (million Euro)	3,236	335	1,938	2,658	8,167
Energy savings (ktoe)	319	113	212	156	800
Energy savings (million Euro)	2,251	175	1,163	736	4,325
Total investment for cost effective EE/RES measures (million Euro)	17860	1,614	5,750	3023	28,247
Sectorial payback period (years)	11.94	9.23	8.24	4.11	6.53

Source: Calculated by the Consultants

The market assessment carried out for EE/RES measures for meeting heating/cooling/hot water energy demand for the residential, public, private and industry identifies a significant level of potential energy savings that could be achieved in Albania by implementing all respective measures mentioned above. Realizing the full energy saving potential based on cost effective measures would require a total cumulative investment of around 28,227 million EUR until 2050 (see above table), which would generate annual cost savings to owners and end-users of about 4,325 million EUR, meaning that the savings would cover the cost of the measures within about 6.53 years for decarbonization of the overall heating/cooling/hot water energy demand for the residential, public, private and industry sectors shows . This conclusion would justify the implementation of all the cost-effective EE/RES measures proposed in this important project. The shortest weighted average pay-back period is for industry (4.11 years) and private and commercial buildings (8.24 years), due to relatively higher electricity prices compared to the residential and public building sectors.

The additional benefit of these energy savings would not be restricted to just the direct owners/tenants of each sector, but would spill over to the economy as a whole. The additional benefits are most often classified into three groups: environmental, economic and social. The first group contains the most important and direct impacts of energy efficiency, such as energy savings and reductions in greenhouse gas emissions. The second group includes, among others, positive macroeconomic impacts on economic growth, innovation and competitiveness as well as import dependency. The third group of impacts covers aspects such as health benefits, poverty reduction and employment. Although the additional benefits of energy efficiency measures are indisputable, they cannot always be measured and quantified. A review and evaluation (where possible) of the more popular measures is set out below.

The largest contribution to the energy saving potential in financial terms comes from the residential sector (52.05%), followed by the private and commercial sector (26.89%), industrial sector (17.02%), and public sector (4.05%). Although the total energy saving potential of municipal and central public buildings is relatively low in comparison with the other sectors, public buildings at present provide the best opportunities for achieving real energy savings because in many cases they already meet the required comfort levels (especially health building and central public building). This fact suggests that any energy efficiency program should begin with the implementation of measures in public buildings and the energy savings and financial benefits resulting from the introduction of EE/RES measures in municipal and central public buildings are also a direct request of EPB Law. Launching the EE/RES implementation program in the central and municipality public building sectors would give a strong message that the government is prepared to lead by example and it would provide a showcase for encouraging other EE/RES initiatives in Albania. This in turn would help to foster a market for EE/RES goods and services and create better access to public and donor funds. On the supply side (that is, in the provision of goods and services that improve EE/RES, such as the installation of efficient heating and cooling systems, Pv Autoproducers (prosumers), Heat Pumps, solar hot water systems, efficient furnaces for industrial sector, etc.), a successful implementation program will create real opportunities for construction, heating and air conditioning companies and they will be incentivized to improve their skills and knowledge in order to win future business.

Analysis shows that in order to capitalize the potential level of energy savings in municipal and central governmental buildings, a cumulative investment for full decarbonization in the amount of €972 million and €642 million respectively is needed. These figures have been used and show that the EE/RES measures proposed for the municipal and central building sectors offer attractive weighted average payback periods – 10.11 years and 9-9.5 years respectively - and therefore the GoA, with the assistance of IFIs and commercial banks, should consider as a priority the implementation of an investment program for public sector buildings.

Despite increased use of local energy resources, such as solar energy and biomass, Albania depends on 10-25% imports of electricity, and 100% import from oil by products which overall accounted for about 35% of its energy primary energy supply in 2023. The introduction of EE/RES measures can enhance energy security by: (a) reducing imports of oil by-products and thereby reducing the trade deficit; (b) cutting down on the consumption of fire wood and thereby preventing deforestation; and (c) minimizing the volume of electricity imports, (d) increasing the RES utilization, (e) reaching full decarbonization of building stock, (f) and reaching NECP respective targets in three building sectors and thereby reducing the need for government subsidies. On the basis of international benchmarks, the cost of implementing EE/RES measures is roughly half the cost of building new energy supply facilities. Energy savings for meeting heating/cooling/hot water energy demand for the residential, public, private and industry sectors show will bring reduction of the total primary energy consumption with 16-20% and thus the reduction of energy imports with 28-30%. Carrying out these investments will generate many benefits for the Albanian economy, including increased energy savings, reduced energy imports and a lower trade deficit, increased life of retrofitted buildings, growth in the number of business and in employment, and a reduction in GHG and acid rain emissions.

The current level of energy consumption in Albania is estimated to be about 102.55 kWh/m2 year (for the whole Albanian occupied building stock for the year 2023), compared to 50–80 kWh/m2 year in Western Europe, which indicates that there is a significant opportunity for EE improvements and reaching comport condition, which is very important for the users of these buildings. Meanwhile, EE/RES measures introduced in industry will help the Albanian industrial to reach their goals for reducing energy consumption and becoming more effective into the very competitive Western Balkan industrial market.

Improvement of the fiscal balance is a high priority for the GoA and EE/RES measures represent an opportunity for the government and the public sector to reduce their energy budget expenditures and the public sector can save large budgets by introducing EE/RES measures in buildings. All EE/RES measures that will be introduced would be a cost-effective measure because investments made in order to improve government facilities will pay for themselves through savings at the national level.

EE investments have a positive economic impact since they contribute to the development of a modern industry that offers jobs and a range of business development opportunities. They also generate revenues from increased taxation on the construction work required for EE implementation, which creates a positive situation, whereby the GoA's need to optimize tax revenues is supported by the development of an EE market with its various associated social and environmental benefits.

The need to achieve mandatory comfort levels in buildings in line with EU Directives and EPB Law on the energy performance of buildings means that renovation of the existing building stock, classified as WPBs, carries a high priority in Albania. Old buildings require immediate investment in thermal insulation, the introduction of efficient double/triple glazed windows and the introduction of efficient space heating and hot water systems. Important energy savings have been identified for other energy services, such as cooking, lighting and in the use of other electrical appliances. This presents an opportunity for the GoA to ensure that such renovations are realized in an energy-efficient way that contributes to the Albania's sustainable economic development.

One of the important conclusions of this project is that the principal challenge facing the EE/RES sector in Albania today is to develop market driven financing mechanisms that will incentivize energy users from across the entire building stock of Albania to invest in energy efficiency measures. Reliance on government supported schemes - and therefore pressure on public funds – will thereby be reduced and the government's role can then be focused on developing legal and regulatory frameworks that facilitate these market mechanisms.

The cost benefit analyses of the buildings that were carried out for EE/RES measures for meeting heating/cooling/hot water energy demand for the residential, public, private and industry sectors show show the most profitable energy efficiency measures to be the introduction of PV Autoproducers, SHWSs, EE LED lighting, the introduction of thermal insulation to outside walls and the introduction of new space heating systems. Another important finding of the cost benefit analyses is that, in all cases, the Economic IRR is higher than the Financial IRR, which demonstrates the importance of increasing energy prices (especially electricity, lignite and fire wood) to the level of their long-run marginal costs of supply without interruption.

Impact on public health (lowering public health costs): Particulate matter, which is an air pollutant, causes 3.3 million premature deaths a year worldwide. Meanwhile, it is important to be mentioned that there are not reported data for causes of premature deaths in Albania linked to the building and industry sectors. The effect of air pollution reduction as a result of energy savings is reported according to the type of energy saved and certain emission factors specific to that type of energy. Emission reductions are assessed for the following main pollutants: nitrogen oxides (NOx), Sulphur oxides (SOx), fine particulate matter (PM2.5 and PM10) and carbon monoxide (CO). However, it is very important to be notice that building stock industry sectors in Albania is consuming approx. 35% of Diesel/LPG and 80% fuel wood, which is much less compared to the transport sector consuming 2.23 times more (706 ktoe). The full decarbonization scenario of Albania's building stock and industry sectors will reduce local air pollution, since electricity from RES, solar energy and efficient biomass technologies, will contribute up to 100% until 2050.

The health benefits associated with the implementation of energy efficiency measures are indirect and relate to the reduction of harmful emissions in the air (sulphury and nitrogen oxides, fine particulate matter, etc.) and the improved heat comfort in buildings and industry sectors. This leads to lower morbidity and mortality rates. The effect of lower morbidity and mortality can also be considered in additional working days and therefore has a monetary equivalent. This parameter is not possible to be calculated for Albania due to absence of data and is considered only as additional qualitative benefit.

Impact on Albania's labor market: Employment effects are determined by two main factors: Investments in EE/RES create jobs for their installations and in the industry that manufactures the products and provides the services concerned, and the energy savings achieved lower demand for energy products in the long term. In turn, lower demand has an effect on the value added produced — a change that affects employment in the sector. EE/RES deployment in the buildings sector is a strategic job opportunity. As technology progresses, new opportunities will be found to improve the energy profile of the EU and reduce import dependency. In 2050, European and global demand for skills in energy efficiency of buildings will still be high and permanent – though they will no longer be seen purely as energy efficiency jobs. Rather, they will have become part of the landscape of everyday activity within the low carbon economy. Jobs have to be seen in terms of business opportunities, many of which are innovative and novel. They exist for energy service companies, for investment funds, for retrofit companies, for sales and distribution, and many more. There will be many more related opportunities in information and communications technology (ICT) as these are incorporated into building management systems.

Looking at the full range of job opportunities, there is a wide range of skills required. In manufacturing, construction and retrofit, distribution and other areas, alongside highly skilled and technical jobs, there are also many positions available for a less skilled workforce, which

currently suffers most from high unemployment rates. For the most part, the labor market is good added value to the economy. Analysis of many EE programmes in EU countries shows, the installation of energy efficient elements and technologies tends to be more labor intensive than manufacturing them, so that when policy is looking for areas of growth, the energy efficiency of buildings should be one of the top priorities. Job development in energy efficiency of buildings is a key field where economic growth brings with it reductions in carbon emissions and increased energy security.

Energy efficiency deployment in the buildings sector is a strategic job opportunity. As technology progresses, new opportunities will be found to improve the energy profile of the EU and reduce import dependency. In 2050, European and global demand for skills in energy efficiency of buildings will still be high and permanent – though they will no longer be seen purely as energy efficiency jobs. Rather, they will have become part of the landscape of everyday activity within the low carbon economy.

In order to determine the employment impact by introducing EE/RES measures for the buildings stock and industry sectors, an EU research study[12] was undertaken to summarize the available information on the number of jobs resulting from energy efficiency investments in buildings – typically as a result of governmental or regulatory schemes in many different EU countries and some other developed countries. Figure IV-28 below shows several data points related to the generation of specific new (green) jobs for 1 million Euro invested in EE/RES measures into the building stock and industry sectors. This data has been collated from over 20 different sources in Europe and North America.

[12] Source: How Many Jobs? A Survey of the Employment Effects of Investment in Energy Efficiency of Buildings a Research by: Rod Janssen and Dan Staniaszek Published May 2012 by The Energy Efficiency Industrial Forum

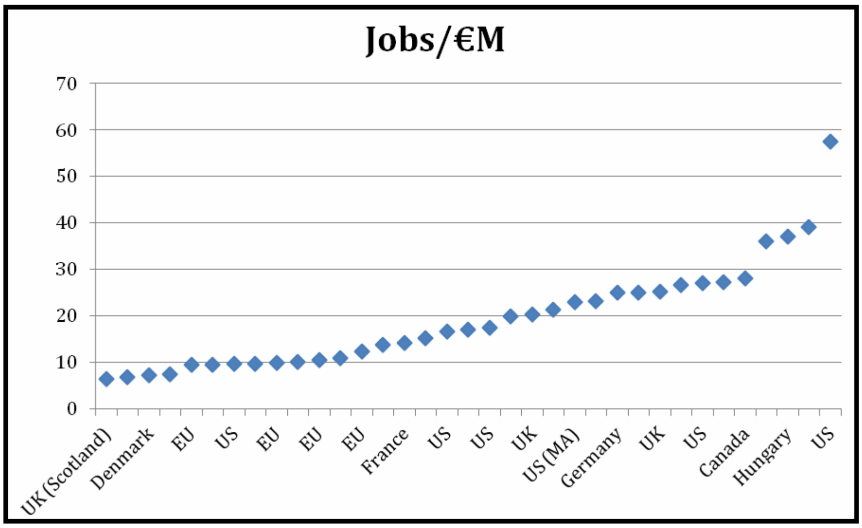


Figure IV-28: Specific new jobs for 1 million Euro invested in EE/RES implemented in building stock and these data were collated from over 20 different sources spanning Europe and America

Source: How Many Jobs? A Survey of the Employment Effects of Investment in Energy Efficiency of Buildings a Research by: Rod Janssen and Dan Staniaszek Published May 2012 by The Energy Efficiency Industrial Forum

The first point to observe is the very wide variation in specific jobs per 1€M investment in EE/RES measures– as an average it can be stated that 20-22 new jobs are generated per 1€M investment in EE/RES measures in building stock.

Second analysis carried out Across Europe on 2022, reached the conclusion that 18 direct jobs are created for every 1 M € invested in EE/RES measures in building stock, and that 1 € invested in the EU construction sector generates 2.2 € in other sectors – making EE renovations an optimum public investment13. If indirect jobs are included the total number of direct and indirect jobs amount 19.5-20 new jobs per 1€M investment in EE/RES measures within the building stock and industry sectors.

The Kosovo Energy Efficiency and Renewable Energy Project (approved in 2014, finalized in December 2023) was designed to reduce fossil fuel use in public buildings through investments in EE/RES and to enhance the broader policy and regulatory environments for both. The project carries out full investment EE/RES installations for 140 buildings owned by the central and municipal government, which received $22 million of the total World Bank investment package. Direct jobs resulted from the design and construction of EE building renovation installation of solar-powered and EE appliances; and training and audits. Indirect jobs were created through demand for inputs, including building materials and appliances. Induced jobs have not been quantified although it is believed that the project may have led to the replication of jobs from increased demand for similar EE/RES investments in Kosovo. The specific ration of new (green) job created for Kosovo was calculated to 20.36 per 1 million Euro invested into renovation of public buildings. Therefore, taking into account these numbers, it can be estimated that energy efficiency and renewable energy renovations across different building sectors and industry sectors will generate significant employment opportunities in Albania, i.e., approximately a total of 35,000-40,000 jobs across the entire building stock and industry sectors.

IV.12 Total Investments requirements and the Estimated Public Support Measures

The table IV-16 shows the required cumulative investment needs for Albania's buildings, DH/CHPs and industrial sectors, aiming for a decarbonized energy sector related to heating, cooling, hot water in efficient way by 2050. The investment needs include the implementation of EE/RES measures for all sectors are presented at the table IV-16. Soft measures (enabling activities) are included within the

[13] https://www.number+of+jobs+created+from+1+milion+Euro+invested+in+energy+efficiency&rlz=1C1GCEU_enAL1160AL1160&oq=number+of+jobs+created+from+1+milion+Euro+invested+in+energy+efficiency

costs until 2030 and there are only 5.27 Milion Euro which will be supported by the annual budget, donors and will serve as the identification of the potential aid element. Total cumulated investment needs will be 25,742 mil EUR by 2050. As, it was mentioned above state budget will secure only 5-6 Milion Euro until 2030 and investment required to rehabilitate public building stock will be via EE/RES Revolving Financial Mechanism.

Table IV-16: Investment required for reaching EE/RES/CO2 targets

Investment needs, million EUR	**by 2030**	**by 2035**	**by 2040**	**by 2045**	**by 2050**
Soft measures (enabling activities)	5.27	-	-	-	-
Renovation of residential building stock	2,765	4,545	8,456	11,245	17,863
Renovation of municipal and central public building stock	280	550	890	1,260	1,610
Renovation of private and commercial building stock	1,324	2,452	3,567	4,622	5,750
Introduction of EE/RES measures for Industry Sector	40.08	61.88	82.98	103.73	134.38
Introduction of DH/CHP schemes	40.5	64.9	97.3	211.7	384.6
TOTAL INVESTMENT NEEDS	**4,455**	**7,674**	**13,093**	**17,442**	**25,742**

Source: Consultant's calculation

Table IV-17 present te summary of total investment required for fully decarbonization of the Central and Municipality Public Buildings stock for the whole period up to 2050 and total cumulative value is 1,610 million Euro. Table IV-17 presents the share of the required yearly investments (Euro) for the renovation of the public building stock for the years 2026, 2027 and 2028. The total investment required amount respectively 37.65 million Euro (2026), 40.08 million Euro (2027) and 35.23 million Euro (2028). Table IV-17 provides also the number of municipal and central public buildings, which should be renovated in the 2025-2027 period.

Table IV-17: Number and investment required for the renovation of municipal and central public buildings as well as soft measures (enabling activities 1-20 presented under the Part IV)

Building sub-category	2026	2027	2028
Number of Municipal Public Buildings to be renovated	149	159	169
Number of Central Public Buildings to be renovated	177	189	201
Number of Total Public Buildings to be renovated	**327**	**347**	**370**
Municipal Public Buildings, million Euro	17.71	18.85	19.99
Central Public Buildings, million Euro	19.94	21.23	22.52
Total Public Buildings, million Euro	**37.65**	**40.08**	**42.51**

Source: Consultant's calculati