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WP T1 – Pilot action
Project Main Output
T1.1 REEHUB network for new energy policy and energy efficiency approach

LP/Pp1: Barleti Institute for Research and Development

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WP T1 – Pilot action
Project Main Output

Manual for Energy Efficiency in Old and New Buildings

Country: Albania

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1. INTRODUCTION AND OBJECTIVES

Albania finds itself in conditions where Energy Efficiency (EE) investments have become strategically important due to the high level of required energy imports, energy price instability and the need for transition to a more sustainable and resilient economy. In addition, energy efficiency investing has a fundamental and beneficial role to play in the development of new infrastructure, new job markets and also it helps increase awareness at its core.

Notwithstanding the "win-win" characteristics of EE investments, existing investment flows in EE in Albania currently are barely starting to increase and to spread value. Currently, with the exception of buildings constructed in the last decade, Albanian buildings have barely no insulation.

According to the EED (Directive 2012/27/EC), Albania will have to achieve an annual 1.5% energy sales savings compared to the recent three-year period through the use of a utility obligation scheme or other alternative approach.

The main objective of this Guide is to present current good practice in order to develop energy efficiency in Albania. This is particularly important as most of the building and materials industries have tremendous potential to increase energy efficiency, product quality and economic added value. This Guide will introduce improvements that could be made to old building stock and also formulate new ways to increase awareness and potential solutions (which are inefficient and lack the required investment for their renovation). It is intended to assist policymakers, competent authorities and any other interested party in Albania in developing and implementing energy efficiency policies and measures at all levels (national, regional and local), thereby paving the way to energy savings in the future.

- The more effective use of public funds, such as EU funds, to trigger additional private financing for energy efficiency and sustainable energy investments, especially in buildings, with a particular view toward implementing the legislation. (1)
- The use of project development assistance in Albania and aggregation mechanisms to support the development of investment project know-how. (1)
- Benchmarking activities on different energy efficiency practices in specific fields (for example concerning different retrofitting concepts or financial instruments for renovation), to identify and promote good practice and foster cooperation actions.

There are two main benefits. (1)

Firstly, by drawing on relevant data and best practice, particularly on energy efficiency, established in buildings with similar local conditions in terms of, building typologies, similar usage profiles and technical systems.
Secondly, in promoting the use of innovative financial and technical instruments in Albania.

2. HISTORICAL DEVELOPMENT OF LEGISLATION OF ENERGY EFFICIENCY IN ALBANIA

The first law on heat storage in buildings is law no. 8937, dated 12.9.2002 "On heat storage in buildings" which aims to create the necessary legal basis for establishing rules and making mandatory measures for heat storage in buildings. Design and construction of buildings to realize the necessary technical parameters for storage, saving and efficient use of energy. All buildings that will be built after the entry into force of this law, to respect the coefficient volume and normative thermal losses, as well as to provide for the installation of thermal heating installation central or local. Heat generation installations for heating and / or cooling of buildings designed to achieve indoor air temperature, according to temperature comfort norms, taking into account the zonal climatic conditions and the functional side of the building. (2)

The first law on energy efficiency in Albania is law no. 9379, dated 28.04.2005 "On the efficiency of energy", which serves as the basis for the first institutional organization in function of energy efficiency. The purpose of this law is to draft the necessary legal framework to promote and improve the efficiency of energy use by determining the economic use of energy resources, the creation of sustainable conditions of energy supply, as well as reducing the harmful impact on the environment. This law defines for the first time the energy audit process as the activity, through which it is realized control and verification of consumption and energy efficiency level, in each energy system. Professional figures defined according to this law are: Energy auditor as a natural or legal person licensed for Energy Performance Certification; Energy conservation service provider as a natural or legal person is licensed, which deals with the implementation of measures to increase energy efficiency. (3)

Achieving this objective of the law is fulfilled, among others, through:

- promoting energy efficiency and investment;
- promoting financial solutions for initiatives aimed at energy efficiency;
- supporting research in the field of energy efficiency;
- Cooperation with other countries in the field of energy efficiency and compliance with treaties; and international conventions, to which the Republic of Albania is a part of, etc.

Institutionally, the law provides for the creation for the first time of the Agency for Energy Efficiency and the fund for energy efficiency.

- Fund created by the Council of Ministers, which is used only for energy efficiency and conservation.

Energy Efficiency Fund, which can be financed by:

a) annual funds of the State Budget, planned for the ministry responsible for energy, which should be used within the budget year.
b) grants of international financial resources;
c) private resources.

- The Energy Efficiency Fund is used to finance the following activities:

a) investments aimed at improving energy efficiency in public and private buildings, in enterprises, industrial and transport sectors;
b) investments aimed at improving energy efficiency in extraction, production and transport or power transmission;
c) research and development activities to increase energy efficiency;
ç) designing demonstration projects, in order to research and test innovative technologies or find solutions organizational innovations for the energy sector;
d) energy audits.

2.1 Legislation in act on energy efficiency

The year 2015 dates an important reform in the field of energy efficiency with law 124 through which is partially implemented in the domestic legislation of Albania a series of directives of the European Union as Directive 2012/27 / EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending directives 2009/125 / EC and 2010/30 / EU. (4)

The purpose of the new law is:

a) drafting national rules and policies to encourage, promote and improve efficient use of energy, with the aim of saving energy and increasing security of supply, as well as removing barriers to energy market;

b) setting national energy efficiency targets;
c) increasing the competitiveness of operators.

The Council of Ministers, respecting every commitment of our country, as a party of the Energy Community and the process of integration into the European Union, sets a national energy saving target, that based on real economic opportunities, primary or final energy consumption, energy saving primary or final, energy intensity. (4)

1. The national energy saving target must be achieved through targeted energy services, increase energy efficiency in specific sectors of the economy, such as residential, services, industry, transport and agriculture, and taking other cross-cutting measures.
2. The national energy saving target is set out in the National Action Plan for Efficiency Energy.
3. The National Energy Efficiency Action Plan is drafted by the Agency for Energy Efficiency and approved by a decision of the Council of Ministers, on the proposal of the responsible minister. National Plan I The Energy Efficiency Action Plan is reviewed every three years and a copy is sent to the Secretariat of the Energy Community.

2.2 The National Energy Efficiency Action Plan contains:

a. the objective of increasing energy efficiency;
b. intermediate objectives for every three years;
c. analysis and evaluation of the achievements of the previous plan;
d. preliminary indicators and specific objectives for energy saving in each sector.

The national action plan for energy efficiency has been approved by a decision of the council of ministers. The first national action plan for energy efficiency is that of the period 2011-2018 which has been drafted based on the provisions of the previous law on energy efficiency. This plan achieved little of the initially set targets for increasing energy efficiency and resulted as mostly unenforceable due to incomplete institutional framework, lack of funds and lack of a clear platform to monitor accurate and timely implementation. During this period the action plan was implemented at a minimum level only for some public buildings that served as pilot projects supported by foreign funds. Since the coming into force of the new law on energy efficiency, two national plans have been drafted and approved by decision of the council of ministers.

The last drafted plan is the one approved by the decision of the council of minister number 709 dated 01.12.2017 which defines as a priority of investments in the framework of increasing energy efficiency kindergarten buildings, schools, hospitals and offices.

The law stipulates the creation of a special fund for financing projects to increase the efficiency of energy. The Energy Efficiency Fund aims to provide financial support in cases of investments to take measures to improve energy efficiency. From this Fund can benefit the companies of production, transmission, distribution and supply of energy, end consumers, energy utility companies and providers of improvement measures energy efficiency. (4)

The fund is funded by:

a) the funds obtained from the agreements between the Republic of Albania, the Council of Ministers and various donors to finance projects implemented by the Energy Efficiency Fund;
b) funds from the State Budget;
c) funds from individuals and institutions, inside and outside the Republic of Albania, according to agreements relevant;
d) income derived from its assets and services provided;
e) other sources, allowed by the legislation in force.

2.3 Programs funded by the Energy Efficiency Fund

The Energy Efficiency Fund is used to finance the following programs, which should be in accordance with the National Action Plan for Energy Efficiency:

a) investments aimed at improving energy efficiency in final consumers;
b) investments aimed at improving energy efficiency in production, transmission and distribution of energy;
c) improving energy efficiency in public lighting;
d) improving energy efficiency in water supply and wastewater treatment systems;
e) development of pilot projects, in order to study and test new energy technologies or new organizational solutions for the energy sector;
f) energy audits to be performed in the public sector;
g) improving metering and billing information;
h) research and development of activities for increasing energy efficiency;
i) awareness campaigns and education activities related to energy efficiency;
j) programs funded under voluntary arrangements, proposed by the Agency.

The legal framework of energy efficiency pursuant to Law 124/2015 was supplemented with the approval of decisions on defining the categories, conditions and requirements of qualification as energy auditor and energy manager, defining the entire process of qualification and certification of experts in the field of energy starting by attending the continuing education program and ending with the provision of the auditor's certificate or energy manager.

In 2016 we have the approval of law no. 116 on energy performance in buildings which implements again Directive 2010/31 / EU of the European Parliament and of the Council of May 19th, 2010, on energy performance of buildings".
The law aims to create the legal framework for improving the energy performance of buildings, by take into account the local and climatic conditions of the country, the conditions of internal comfort of buildings as well as efficient costs. (4)

In 2020 the following are approved:

- Minimal energy performance requirements of buildings and building elements
- Methodology for calculating optimal cost levels for minimum performance requirements of energy of buildings and elements of buildings;
- National Calculation Methodology energy performance in buildings;

The above acts partially approximate the delegated regulation of the Commission (EU) no. 244/2012, of 16 January 2012, which complements Directive 2010/31 / EU, of the European Parliament and of the Council, on energy performance of buildings, setting a framework of comparative methodology for calculating the optimal cost levels for the minimum energy performance requirements of buildings and building elements

2.4 Energy performance certification of buildings

- Energy performance certification of buildings should be mandatory for:
- all buildings or units of buildings, which will be sold or leased;
- all buildings, which will be constructed or subject to significant renovation;
- all buildings that are in use by a public authority or by the institutions that provide them a service to the public and often frequented by the public, which have an area of usable over 500 m^2.

3. ACTUAL SITUATION IN ALBANIA

According to the 2011 registration, the general number of residential buildings in Albania was 598,267 for a population of 2,821,977 people (53.5% of the population lived in urban areas and 46.5% in rural areas). The total number of households was 1,012,062, out of which 722,262 were private houses. According to the data of the same registration, only 709,865 households were inhabited. (5)

The building stock has been classified in 20 building types. Figures 1 and 2 show the number of the buildings and of the households for all construction type.
Individual houses built between 1991 and 2000 represent the largest group with 108,752 buildings. Apartments built between 1961-1980 and 1981-1990 are the other important groups concerning households. Also, Figure 1 shows the number of households without construction date and also the one without inhabitants. (5)

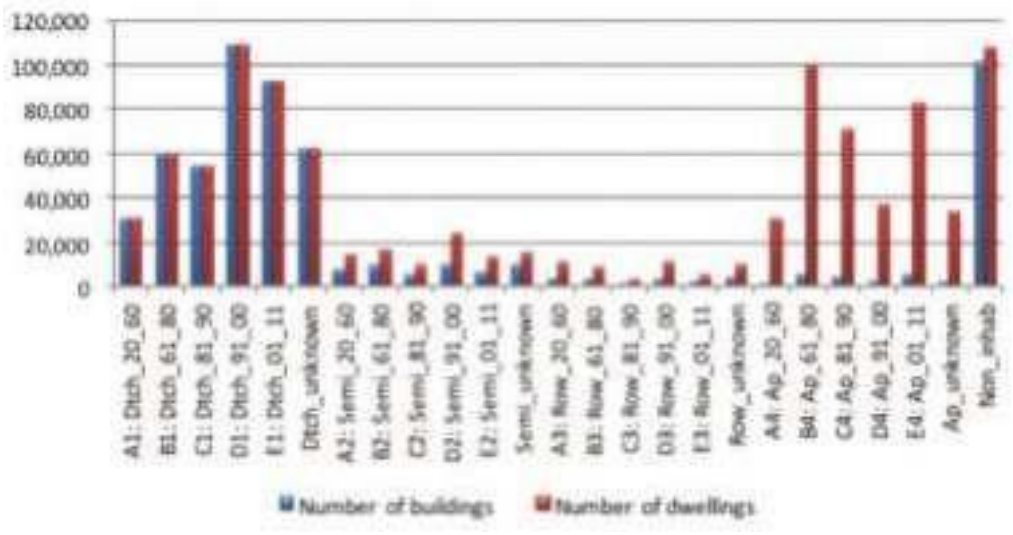
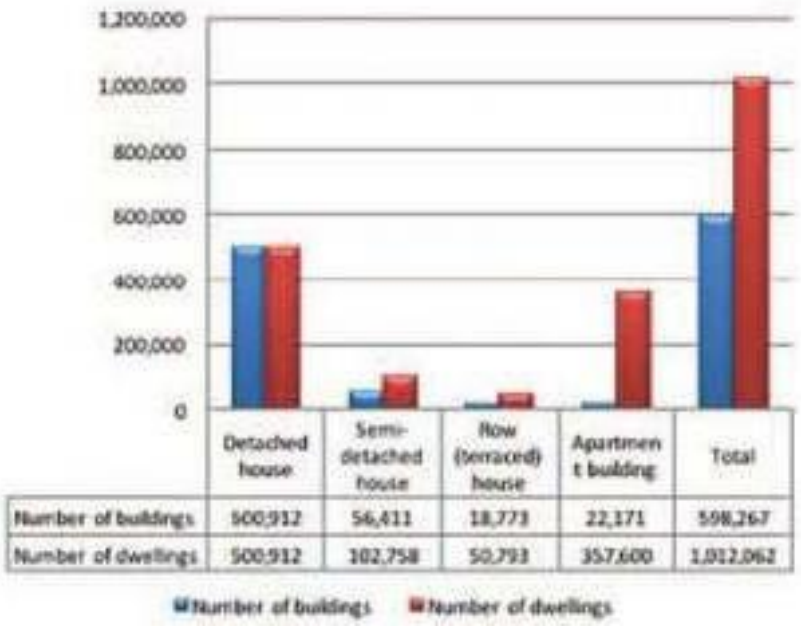


Figura 1 Number of dwellings



	Detached house	Semi-detached house	Row (terraced) house	Apartment building	Total
Number of buildings	500,912	56,411	18,773	22,171	598,267
Number of dwellings	500,912	102,758	50,793	357,600	1,012,062

Figura 2 Number of dwellings by type based on INSTAT 2011

Construction materials and the most used technical systems.

It was impossible to secure detailed data for the construction materials in the 2011 registration, although in the 2001 registration there were some data. Most of the building stock was built with bricks ore stones (88%) and 5% was with prefabricated materials (Figure 3). Although the number of buildings with prefabricated materials is lower than the one with masonry tool-work materials (bricks and stones), they are multistory buildings that have many apartments. Most of the residential buildings,

built after 1960, are constructed using prefabricated blocks technology. “Other” construction materials include pug and clay. (5)

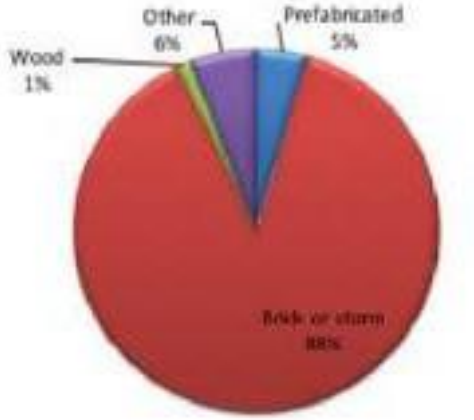


Figura 3 Buildings according to construction materials

After 1960, residential buildings have been built using prefabricated technology using a “sandwich” type insulation, which was part of the construction panel. Buildings constructed during peak years, during the 1990s had partial or insufficient insulation. (6) But also during the 2000s, building codes were not very restrictive and many buildings did not fulfill the required criteria. Generally, thermal insulation is very poo and energy consume is high. Part of the building stock has been renovated. The most common interventions are thermal insulation and roof hydro-insulation and the replacement of old windows/doors with double glass windows/doors. (6)
Data in relation to primary energy used are available only for individual residential dwellings. According to the 2011 registration, the most common energy source was wood (57.5%), followed by gas (20.8%) and electricity (15.4%) (Figure 4). Solar heating and other energy sources, like coal and Oil are insignificant. Approximately 6% of residential houses do not have heating according to the 2011 registration. There is a substantial difference between urban and rural areas: In rural areas wood usage for heating prevails in respect to urban areas.

Poverty and inequality are a serious problem for these areas. In cities, the situation is more balanced: the three main primary energy sources are wood (36.3%), electricity (24%) and gas (31.3%). There are differences between the three climate zones. In the mountainous regions, climate zone C, prevails the usage of wood, which is used in 96% of individual houses. In climate zones A and B, roughly half of the houses are heated with wood, but a considerable percentage is heated with electricity and gas.

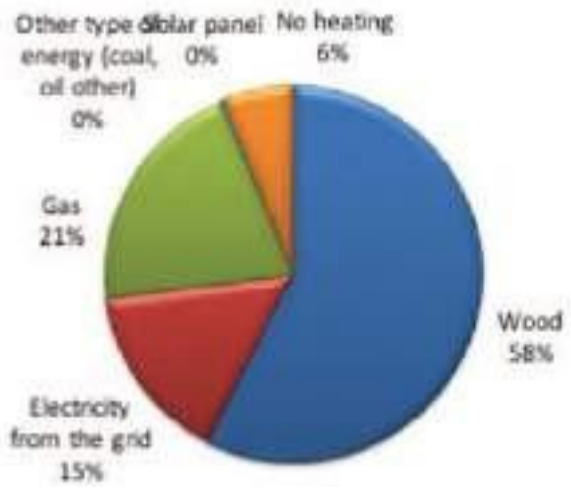


Figura 4 Buildings according to primary energy used for heating

In climate zone A, roughly 9% of the houses are not heated. Natural Resources National Agency statistics show a different overview regarding the percentages of the heating sources. The share of electricity is much higher than in the 2011 registration data. Also, the usage of electricity has the tendency of growing: from 44% in 2012, electricity reached 50% in 2013. Gradually we have a lower wood consumption and liquified natural gas. Regarding the climate zones, electricity dominates in zone A, whereas wood in zone C. Anyhow data values are very different than in the registration data and there should be a new data gathering to create a better general panorama. (7)

According to the registration, 6% of the dwellings are equipped with air conditioning. In climate zone A, 4% of the dwellings have air conditioning and in climate zone B, 9%
Generally, most of the cooling systems are reversible and can be used for heating also. According to AKBN statistics (Natural Resources National Agency), the usage of air conditioning is much higher. Nevertheless, the usage of these units for cooling is not sustained with statistical data. (5)

The registration did not include questions for domestic hot water supply, although one of the main general characteristics of a dwelling in Albania is the domestic hot water supply with electric boilers. This is sustained by AKBN data, according to which, on the national level, 625 of the energy consumed for domestic water heating comes from electricity, 23% from wood, 105 from LNG and 5% from solar energy. In climate zone C, the percentage of using wood as an energy source is much higher than in the other climate zones, taking into consideration dwellings with similar characteristics. (5)

4. BUILDING TECHNOLOGIES AND HYGRO-THERMAL COMFORT

The hygro-thermal comfort (ICQ) is defined as the psychophysical state in which the subject expresses a condition of well-being with respect to environmental variables, a condition known as thermal neutrality. Furthermore, the ICQ represents one pillar of the holistic concept of the Indoor Environmental Quality (IEQ). The methods for the assessment of ICQ and recognized at international level are mainly two. The former, based on a steady-state approach, described by the EN ISO 7730:2005 and applied to Fully Mechanically Controlled buildings (FMC) equipped with an active conditioning system. The latter, based on an adaptive approach, as defined trough in field activities and described by the technical standard ASHRAE 55 and EN 15251, instead, considers the users as active subjects that interact with surrounding environment and are influenced in their comfort perception by external conditions. In this case, the thermal comfort concept is not just defined depending on physical, but also psychological, social, economic and cultural aspects. The technical standards provides that this method could be applied in middle seasons when the control of comfort is handled by passive technological methods, i.e. in the so called Natural Ventilated or Free Running buildings (FR). In this approach, methodologies providing the direct involvement of the end users are consolidating, through the collection of physiological, psychological and behavioural personal data as to obtain the better assessment of the comfort conditions. (8)

5. ADRESSING ENERGY POVERTY

Energy poverty is particularly relevant in Albania, with more than 37% of households experiencing energy poverty. Families with economic liability see their health and economic resources severely affected during winter but also during the extreme summer heat, when many households encounter difficulties into fulfilling their needs. This phenomenon is a occurring due to financial instability, difficulties to access alternative and cheaper energy resources, and due to increasing demand. In Albania currently it is difficult identify or quantify energy poor consumers, and therefore struggle to provide adequate measures to target energy poverty. Awareness of energy poverty is growing in Albania and has been identified as a policy priority by the Albanian Government. The issue is increasingly integrated within the activities of the European Union, as evidenced by the European Commission's flagship legislative proposal package "Clean Energy for All Europeans"24, which was presented on 30 November 2016. (1)

5.1 Low-Cost Measures to Tackle Energy Poverty

The project aimed to empower households to save energy, while simultaneously establishing energy poverty as an issue that demands tailor-made structural measures at local, regional and national levels.

a) Improve technical capacities for energy professionals to strengthen the energy efficiency projects implementation steps and to improve deliverables
b) Increase trainings for professionals with the aim to overcome the lack of personnel and organizational capacities due to demographic movements and the dynamic change and development of the energy market.
c) Improve networking, cooperation and dialogue of the practitioners at the regional, national and international level by increasing access to conferences and events and training with digital platforms and tools for technical analysis.
d) Improve decision making analysis for sustainable urban and mobility plans and strengthen monitoring and reporting
e) awareness-raising on CO_2 emissions especially in schools and communities with difficult access to education
f) apply energy efficiency measures targeting specific sectors especially those with high visibility (e. g. culture/tourism, construction, public buildings, etc.)
g) Improve cross-border energy networks
h) Integrate energy efficiency plans within RES (Renewable Energy Sources) strategies
i) Fasten the adoption of EU rules on energy

5.2 Investment in EE tools to reduce energy spending

Currently there is high demand in investment due to new regulation for EE Buildings. At the same time there is lack of local engineering expertise on the implementation and monitoring process on performance of machineries for industrial processes and implementation, operation and maintenance of photovoltaic plants. There is high potential for long-run investments on other non- energy products and services, by improving construction materials and decreasing energy bills with process optimization. It is imperative for individuals and companies to apply and invest into tools and equipment adhering EU standards. These measures will reduce investment risks and also will improve operational and maintenance costs. Investing in this area will create a long run benefit for all stakeholders and on the macroeconomic environment. (9)

The direct benefits will be:

1. Energy use reduction;
2. CO_2emissions reduction;
3. Life cycle cost reduction;
4. Reduced energy bills.

Co-benefits will be:

1. Improvement of the overall quality of the building;

2. Improving IEQ and user health and well-being;
3. Economic benefits, tackles reduced energy poverty of families;
4. Added value for the renovated buildings, services and materials.

Macro-economic benefits and co-benefits

1. Direct benefits (Reduce energy imports)
2. Co-benefits (improved health and environment)
3. Opportunities for capital expenditure on other areas in need
4. Stimulating economy and increase of competitiveness

Refurbishment in an nZEB perspective of the school buildings and hospitals because it can lead towards the de-carbonization of the schools and hospitals building stock in shorter time than those expected in the 2030 and 2050 climate and energy frameworks, due to the sustainability of the country's grid. (9)

5.3 Investing in energy efficiency

These investments cannot create added value exclusively with public grants. Considering that this form of investments is presently the most important driver for investments, it will be needed more private financing. In spite of the fact that energy efficiency is often considered to be the first opportunity at economic level, still it is difficult to implement cost-efficient investments, real acting interest in this area is not sufficient since there are very few financing solutions tailored depending on the specific needs and individual characteristics. Deliverables and lack of quantifiable practical data, other than in scientific research is very low. (9)
The finance sector is very interested to invest in energy efficiency and process optimization, however there are many obstacles on decision making, economic and technical solutions. Investments rather small and rare between based on instant, emergency and short-term needs, other than being tailored on long run benefits. This leads to high costs and high risks of investments and thus it becomes difficult to establish a new stable market. Another key issue is the insufficient demand to justify setting up new products in a new market. In short, the sector has the capacity but does not find suitable projects to invest in, because most projects do not fit its expectations. This is despite the fact that many project promoters are developing good technical projects. (9)

With the new clean energy and sustainable development package, the Albanian Government or other interested parties should launch initiatives for smart financing for smart buildings. These initiatives should consist of essentially three pillars:

1. Going towards a more effective use of public funding, by using financial instruments such as loans and risk-sharing schemes. Three of these possible schemes are presented below.

2. Secondly, on data gathering and technical assistance for project development, through specific funding dedicated to project development activities and the establishment of one-stop-shops for project developers, covering the whole customer journey from information, technical assistance, structuring and provision of financial support, to the monitoring of savings.

3. Finally, on de-risking energy efficiency investments through the development of digital databases for technical and financial performance track record of energy efficiency investments, which would be a publicly accessible tool guide on evaluating and financing energy efficiency projects.

The Albanian Government, banking institutions, cooperation organizations and business developers should aim to increase the market uptake of energy performance contracting models through large-scale capacity building for local public authorities and their project partners in the design, development, tendering, contracting and implementation of EPC projects.

Currently there are three main financing models that are having successful results and creating added value:

1. CAPEX model

Capital expenditures are referred to funds which are use from a company/developer to buy, improve or maintain long term assets, to maximize earnings. Long term assets are usually physical assets, fixed and non-consumable assets like property (land), equipment or infrastructure, and that have a useful cycle of more than 1 accounting year.
Otherwise known as CapEx, capital expenditures include buying new equipment, machinery, production plants, building systems, work vehicles, software or other assets like patents and licenses. The amount of expenditure for an accounting period is taken into consideration in the cash flux report. Capital expenditures normally have an important effect in the short-term and long-term financial situation of the developer. It is a business model that requires high initial capital investments but with shorter time of return and with lower risk if the analysis is completed carefully. It has very high development potential.

2. Pay-As-You-Save model

The objective of the "Pay-As-You-Save" scheme is to raise efficiency in the private sector and to ensure that the consumer has real benefits from the decrease of the energy bills, to increase energy security of a country through the reduced demand for fossil fuels and to reduce carbon emissions.
A PAYS scheme theoretically is the usage of private funds, mainly financing through necessary initial capital investments. The principle is that an institution supported by the government, a bank

supported by the government, or legislation supported by the government would enable loaning with preferential interests which would decrease the risk burden for the initial investment on energy efficiency measures implementation and renewable energy systems investments for different developers.
The PAYS comes in the end, when even though the client is paying the loan, the saved earnings are partially used to finance those payments and making it more manageable and by putting the client in a more comfortable position.

3. Shared-Savings model

"Shared-savings" is a payment strategy that offers incentive for the developers to reduce expenditures for energy by offering to the consumers a percentage of the net earnings achieved as a result of the initial investment. This concept raises attention and interest because it creates common energy services companies, thus creating a payment scheme based on performance. To accomplish this scheme is imperative the inclusion of developers and consumers, public agencies involved in "Shared Savings" deals, negotiating the different interests by including the target groups and services that will be covered and also the way these savings will be calculated and accounted.

6. ZERO ENERGY BUILDINGS IN ALBANIA

Since its introduction in 2010, the nearly Zero Energy Building (nZEB) concept has known a large diffusion in EU countries. Unlike the European Union, Albania (as a potential candidate) is paving the way towards its introduction by transposing EU directives in the fields of energy efficiency into its national legislation. This general description is focused on the identification of retrofit solutions leading to a best practice level of nZEB in Albania, by relying on locally available and affordable technical solutions. The objective of the nZEB building analysis methodology deals with the following tasks: a) assessment of the actual building's performance; b) identification of target performance and suitable intervention actions; and c) assessment of the refurbished building's performance. (10)

The reduction of Greenhouse Gas Emissions (GHG) and consumption of energy resources is still a challenge in the agendas of all states. The improvement of the energy efficiency of the building sector offers a real chance to achieve the requirement for a low-carbon future (*Energy Roadmap 2050*). This goal is possible thanks to the full implementation of the Zero-Energy Buildings (ZEB) concept. (10) Buildings are responsible for 35-40% of the total energy consumption worldwide. The potential offered by the sector in the reduction of energy consumption is huge, considering that large part of the building stock consists of buildings dating back to periods with absence of attention towards the energy related issues. The European Union (EU) has given a particular attention to this aspect for more than two decades and over the year many successful case studies in all Member States have been developed. A significant stimulus was offered by the introduction of the nearly Zero Energy

Building (nZEB) concept which has engaged (and still engages) scientific community, professionals and construction companies in the identification of innovative and sustainable solutions in the energy, environmental, economic and social point of view. (10) Nowadays, all European countries have established their own national energy certification systems and requirements for the nZEBs. However, different degrees of implementation are observed among EU countries. On the other hand, in the aspiring candidate countries the situation is even more fragmented. (10)
In recent years, Albania has transposed two important EU directives into its legislation, highlighting the will to increase the energy efficiency of its building stock. Indeed, Law nr. 124/2015 (on Energy Efficiency) and Law 116/2016 (on Energy Performance of Buildings) are the transposition of the Directives 2010/31/EU and 2012/27/EU, respectively. The same for the building envelope elements, plants requirements and the exploitation of the renewable energy sources (RES) leading to a better energy performance. New constructions and retrofit interventions reflect the most this clear framework, giving freedom of choice to designers with useful guidelines leading to a better energy performance of the national building stock. (10)

Although the energy efficiency framework in Albania is "under-construction", the introduction of the nZEB concept in the refurbishment of the existing school buildings may bring many positive outcomes. In Law nr. 124/2015, nZEB is mentioned the same as in the directive 2010/31/EU, but as normal praxis, it should have been followed by a nZEB national plan defining metrics and technical requirements for new buildings and refurbishment of existing ones. Besides being energy-performant, buildings produce the low amount of energy required by exploiting RES to decrease of reliance from the grid, usually known for transmitting non-renewable energy and responsible for the GHG emissions as well. Precisely the grid is a point where Albania and EU data differ. In 2017, Eurostat highlighted that 69 % of electricity consumed in the EU derived from non-renewable sources and the remaining 31 % from renewable sources. In same proportions was the production of energy, 71.1 % from non-renewable sources and 28.9 % from renewable sources. (10)Although non-renewable sources still prevail, emissions have decreased by 23 % in 2018 compared with the levels registered in 1990, going beyond the 20 % goal of 2020 climate and energy framework. The importance of nZEBs is remarked in the 2030 and 2050 climate & energy frameworks aiming the reduction of GHG by 40% and 95 % respectively and to the decarbonization of the building stock. (10)
On the other hand, the implementation of nZEB in Albania concept in new constructions and refurbishment of existing buildings can have a great impact on the energetic panorama because of:
a) the current state of the grid; and b) the availability of renewable resources. Indeed, most of energy demand is produced by crude oil (53.3%) and renewables (46.7%) whereas the production of electricity derives for more than 90% from hydropower. The second aspect, related to its geographic position, guarantees high potentials of solar and geothermal energy. In particular, the annual solar exposure ranges between 1,185-1,690 kWh/m2, with an average of 1,500 kWh/m2. From these considerations, the nZEB concept in Albania should not be perceived as: a) urgent, because of the different energetic and environmental situation in comparison with the EU; b) impossible, no

necessity to avoid the grid or establish low U-values for building envelope elements as in Northern EU countries' building code. However, it should be approached as an opportunity: c) to increase energy performance of the building stock; and d) to contribute enormously to the achievement of important goals, included 2030 and 2050 climate and energy framework even sooner than actual EU countries, too. (10)

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WP T1 – Pilot action
Project Main Output

Manual for Energy Efficiency in Old and New Buildings

Country: Montenegro

OVERVIEW OF THE ENERGY EFFICIENCY POLICY IN MONTENEGRO

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This document was conducted in the activity Hiring experts for energy efficiency in buildings, tender number: REEHUB Plus - T02, which is part of the "REEHUB Plus" projects. This project is implemented as part of the Interreg IPA cross-border cooperation program Croatia - Bosnia and Herzegovina - Montenegro 2014-2020, financed by the European Union.

1. Energy consumption in Montenegro

Energy demand in Montenegro is increasing in all energy consumption sectors, except for the industry sector. The reason for such trends could be found in intensive economic activities in tourism and construction, which impact energy consumption in all sectors of energy consumption: households, services, and transport. Data on final energy consumption in the last four years (2016-2019) are shown in Figure 1 (2020 was excluded from the analysis as uncertain due to the COVID-19 pandemic). The official energy balance for 2021 is not yet available.

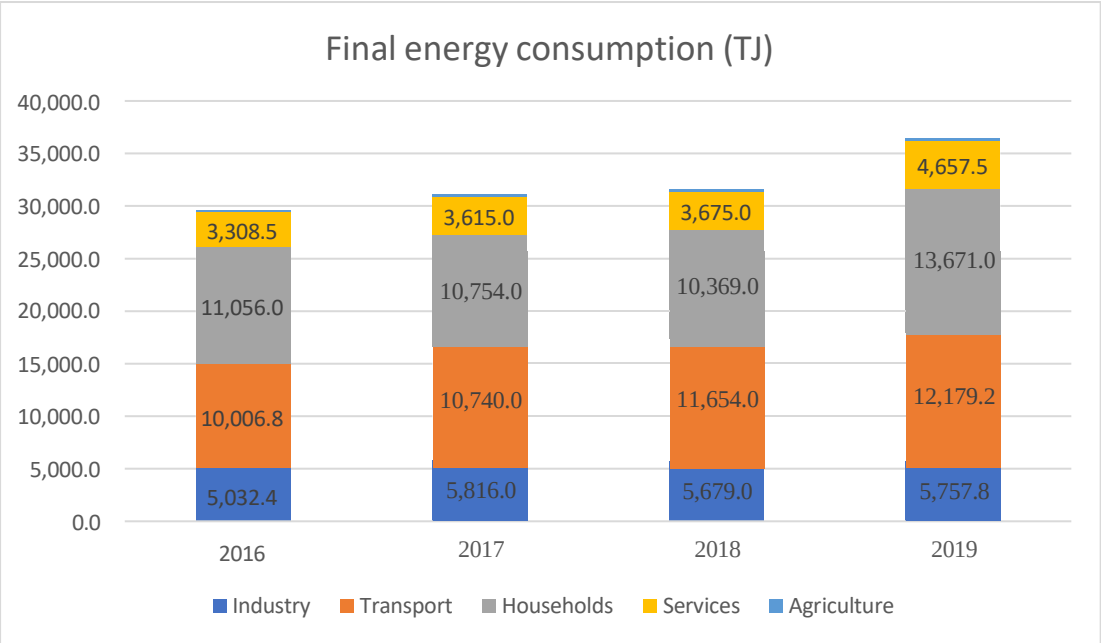


Figure 1: Overview of final energy consumption, 2016-2019 (TJ)

Energy consumption in the industry sector is mainly concentrated in two facilities: Aluminum Plant Podgorica and Steel Plant Niksic. Both have faced serious problems in operation in 2021/2022 due to the high energy prices on the global market.

The transport sector also has a significant share of energy consumption, around 30 %. However, the government's efforts to reduce consumption in this sector were relatively modest in the previous period.

Therefore, the energy efficiency policy of the Government of Montenegro is primarily oriented toward the improved energy performance of the building, which is the largest consumer of energy in the country and has a huge potential for achieving energy and economic savings, as well as positive impacts on the environment. Energy consumption in the

building sector in Montenegro is dominantly related to energy consumption in households, as well as energy consumption in services (public and commercial). Based on the available data, it is evident that the participation of these two sectors in the final energy consumption in 2019 reached over 50% (Figure 2).

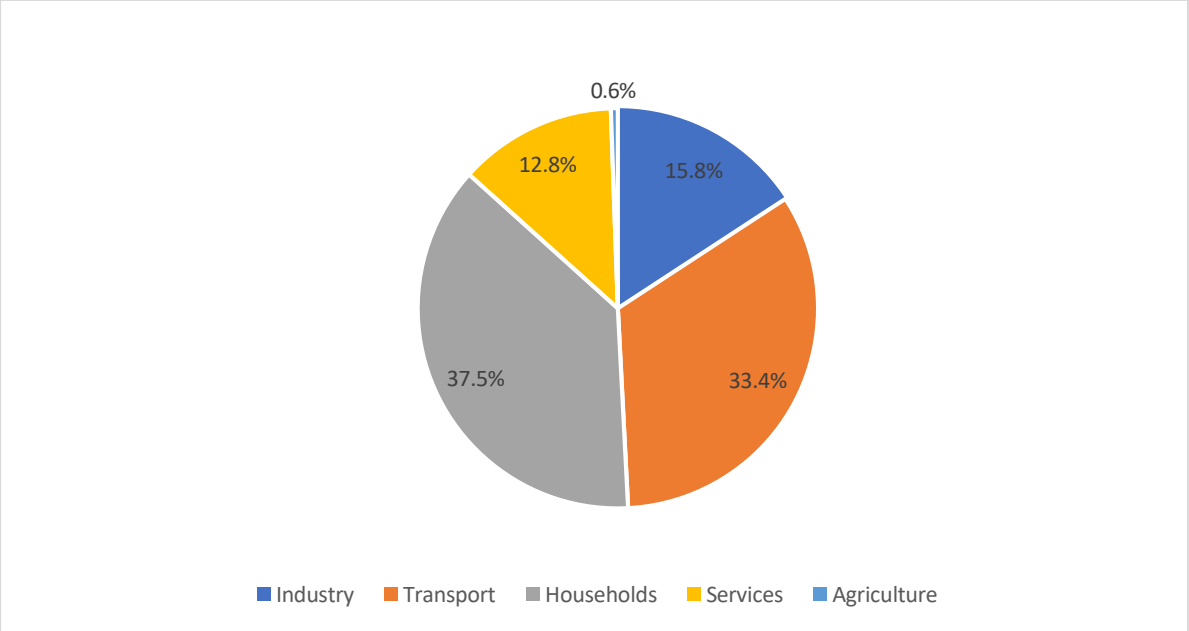


Figure 2: Structure of final energy consumption in 2019 (%)

Regarding the quality of building construction, from an energy efficiency perspective, it is crucial to keep in mind that most buildings are built before 1990 and have relatively low energy performance. Although some of these buildings initially had thermal insulation, it is currently not functional due to the buildings' age and inadequate maintenance. However, installing thermal insulation on buildings and joinery with better thermal characteristics has been evident in the last years, resulting from the increased awareness of investors and customers. The obligations are defined in the regulation for minimum energy efficiency requirements (in force from 2013).

The dominant use of electricity for space heating in residential buildings, especially in urban areas, is a consequence of low electricity prices in the past and the convenience of using electric devices for space heating. In the last 15 years, the use of heat pumps/air conditioners, often the only heating source in residential buildings, has increased. However, many of these devices have relatively "low" performance, primarily due to poor quality and poor maintenance. The regulation introducing the ban on placing inefficient air conditioners on the

market has been in force since 2019, so substantial effects are expected in the coming years. An increase in electricity consumption is also evident in the summer due to the massive use of air conditioners for space cooling.

In rural areas, especially in the northern part of Montenegro, biomass (wood) is considerably used for room heating. Natural gas is unavailable, and district heating is not developed except in the Municipality of Pljevlja. Electricity is also dominantly used for the preparation of hot water in households. Thermal solar systems are rarely used, and photovoltaic systems on buildings (household and services) are possible/encouraged by the Government from 2021.

2. Legal framework for energy efficiency

The field of energy efficiency in Montenegro was legally regulated for the first time in 2010 by the Law on Energy Efficiency, following the valid legal framework in the EU. The legal setup was improved in 2014 by adopting the Law on Efficient Use of Energy (Official Gazette of Montenegro, No. 57/2014), harmonizing with the new EU directives in this field.

- Directive 2012/27/EU on energy efficiency (EED);
- Directive 2010/31/EU on the energy performance of buildings (EPBD);
- Directive 2010/30/EU on the indication by labeling and standard product information of the consumption of energy and other resources by energy-related products and
- Directive 2009/125/EC establishes a framework for setting ecodesign requirements for energy-related products.

The Law on Efficient Use of Energy regulates relations in the field of energy efficiency in the sectors of final consumption, obligations to adopt/implement programs and plans for improving energy efficiency at the national and local levels and the level of energy entities and consumers, as well as all other energy efficiency measures and responsibilities for its implementation. The Law does not refer to energy efficiency in production, transmission, and distribution, and energy efficiency in these sectors is regulated by the Law on Energy.

Undertaken international obligations within the membership in the Energy Community and under a process of accession to the European Union require constant monitoring and harmonization of national legislation with the EU acquis. Changes to the necessary directives in this area at the EU level occur every 2-3 years, and they need to be taken into account through appropriate improvements to the national legislation.

Therefore, the Government of Montenegro and the line ministry, the Ministry of Capital Investments, are required to improve the legislative framework in this field continuously. The

last time Law on Efficient Use of Energy was amended in 2019, and the following changes were made:

- Introduction of centralized reporting on the implementation of energy efficiency measures and achieved energy savings by all entities recognized by Law,
- Introduction of a long-term building renovation strategy for buildings,
- Improvement of the framework for energy management in the public sector,
- Establishing an inspection for energy efficiency for enforcement of legal provisions.

New amendments to the Law on Efficient Use of Energy are currently being prepared (expected to be adopted by the end of 2022) to improve the scheme for energy performance certification of buildings in Montenegro.

Table 1: Status of transposition of EU acquis in the EE field

EU Acquis	National legal framework
Directive 2012/27/EU on energy efficiency (EED);	Amendments to the Law on Efficient Use of Energy (2019) – EE on the demand side Law on energy (2016, 2020) – EE on the supply side
Directive 2010/31/EU on the energy performance of buildings (EPBD);	Law on Efficient Use of Energy (2014) and relevant by-laws
Directive 2010/30/EU on the indication by labeling and standard product information of the consumption of energy and other resources by energy-related product	Law on Efficient Use of Energy (2014) and relevant by-laws
Directive 2009/125/EC establishes a framework for the setting of ecodesign requirements for energy-related products	Law on Efficient Use of Energy (2014) and relevant by-laws
Directive (EU) 2018/844 amending Directive 2010/31/EU on the energy performance of buildings and Directive 2012/27/EU on energy efficiency	Amendments to the Law on Efficient Use of Energy (in the procedure of adoption)

Regulation (EU) 2018/1999 on the Governance of the Energy Union and Climate Action	Amendments to the Law on Energy – NECP is introduced as a critical strategic document
Regulation (EU) 2019/826 amending Annexes VIII and IX to Directive 2012/27/EU on the contents of comprehensive assessments of the potential for efficient heating and cooling	Not transposed yet – will be subject to future amendments to eh Law on Energy
Directive (EU) 2019/944 on standard rules for the internal market for electricity and amending Directive 2012/27/EU	Not transposed yet – will be subject to future amendments to eh Law on Energy

Adoption of the Law is followed by preparation and adoption of by-laws to complete the legal framework for the successful implementation of the Law. By mid-2022, 57 by-laws have been adopted, which more closely regulate aspects of energy efficiency following EU practice.

An overview of the status of the transposition of the EU acquis in the field of energy efficiency into the national legal framework in Montenegro is given in Table 1.

Significant progress was achieved in the following areas relevant to this report:

- Energy efficiency in buildings;
- Energy labeling and eco-design of energy-related products;
- Energy management in the public sector.

2.1. Energy efficiency in buildings

The development and enforcement of the regulatory framework for energy efficiency in buildings is a measure that ensures compliance with energy performance standards. Enforcement mechanisms include applying minimum energy efficiency requirements and control of the energy performance certification for new and reconstructed buildings.

The process of transposition of Directive 2010/31/EU on the energy efficiency in buildings (EPBD) in Montenegro has started with the adoption of the Law on Efficient Use of Energy (December 2014), as well as with the update of the relevant by-laws in 2015:

- Rulebook on Minimal Energy Efficiency Requirements in Buildings ("Official Gazette of Montenegro," No. 75/15 of 25 December 2015) defines the minimum requirements

related to the energy efficiency of buildings, types of buildings that, according to their purpose, are not required to meet minimum energy efficiency requirements and methodology for calculating the energy performance of buildings;

- Rulebook on the Energy Performance Certification of Buildings ("Official Gazette of Montenegro," No. 75/15 of 25 December 2015) which defined in a detailed manner certification of buildings, manner of determining the energy class of building, layout, and content of the table with the actual energy performance of public buildings, the range of certificates and registry of issued certificates on the energy performance of buildings and types of facilities, which are not certified, according to their purpose.

- Rulebook on Performing Energy Audits of Buildings ("Official Gazette of Montenegro," No. 75/15 of 25 December 2015) determines the methodology for building energy audits.

- Rulebook on Regular Energy Audits of Heating Systems and Air-conditioning Systems ("Official Gazette of Montenegro," No. 76/15 of 28 December 2015) determining the manner and deadlines for performing regular energy audits of air conditioning systems of the nominal power of 12 kW and larger and gas, liquid or solid fuels heating systems of the nominal capacity of 20 kW and larger;

- Rulebook on Conditions for Performing Training, Obtaining of Authorization and Manner of the Managing of the Registry for Energy Audits Performing ("Official Gazette of Montenegro," No. 75/15 of 25 December 2015) determining the training program for energy audits of buildings and regular energy audits of heating systems and air conditioning systems, conditions for performing training program for energy audits performing, the content of the application and documentation to be submitted with the application for issuing authorizations to conduct energy audits and licenses to complete a training program and examination for energy auditors as well as the content and method of keeping a register of authorized persons for energy audits and authorized organizations for the implementation of a training program and examination.

This significantly improved the legal basis for implementing obligations required by the EPBD directive in practice. However, in practice, the prescribed duties are implemented only to a certain extent:

- Minimum energy efficiency requirements have been established, and their application is controlled during buildings design;

- Certain capacities for performing energy audits of buildings and regular inspection of heating systems and air conditioning systems exist, but their engagement is limited due to the low requirement of the market;

- Procedures and conditions for obtaining authorization to perform energy audits have been defined and are being implemented.

However, the conditions for buildings' energy performance certification have not yet been created in Montenegro, which would result in greater engagement of experts for energy audits and the possibility of controlling the application of defined minimum requirements during building construction. The main reason for this is the lack of national software for the calculation of energy performance of buildings, as well as the lack of relevant data on the building stock in Montenegro (number, structure, ownership, construction period, construction and technical characteristics, etc.).

To overcome this issue, the Ministry of Capital Investments, in cooperation with KfW bank, provided support for:

- **Development of the building stock inventory** with the definition of referent buildings and cost-optimal calculation. In total, nine reference buildings are defined - three building types (single-family houses, multi-family houses, and office buildings) for three construction periods. The development of cost-optimal calculations, which will result in new energy performance requirements, is in the final stage, and it is expected to be finalized by the end of 2022.

- **Development of national software for the calculation of energy performance of buildings** in cooperation with Fraunhofer Institute from Stuttgart. This software is designed to be adapted to specific countries' needs and regulations on energy efficiency in buildings. The first version of the software for calculating the energy performance of buildings (MEEC — Montenegrin Energy Efficiency Certification) was finalized and is available for download (www.meec.me).

- The software and the underlying calculation methodology are compatible with the EPBD 2018 in terms of the calculation and the requirements for the quality control system of energy performance certification. The energy demand calculation of a building itself is based on a calculation API called ibp18599kernel, which was first introduced in 2005 and is constantly validated, updated, and quality-checked. However, by using a well-running calculation library, the focus of the implementation did not have to be on the calculation itself (and especially again, the validation of the calculation itself) but on the user interface and especially the customization abilities of the software itself. Therefore, it is designed to run as a national application with

national values for user profiles, climate zones, DHW demand profiles, minimum values for the U-values of the building envelope, and even additional calculation routines.

- MEEC software is primarily developed for energy auditors, but it will be available to all interested parties (designers, students, etc.). MEEC can generate certificates and upload them to the central register of energy certificates.

MEEC Software

MEEC software is applicable for residential and non-residential buildings, as well as for new and existing buildings. Certain modifications and adaptation of the DIN V 18599 calculation methodology have been made to comply with applicable regulation that determines the method for calculating the energy performance of buildings in Montenegro (Rulebook on the minimum energy efficiency requirements of buildings). This primarily refers to climate data (three climate zones in Montenegro) and the data contained in the user profiles.

Concerning the technical systems in a building, MEEC offers three possibilities: (i) use of HVAC wizard (simplified approach); (ii) use of HVAC wizard to start defining systems parameters in more detail; (iii) use of expert mode (detailed approach).

In the wizard mode, the technical systems are automatically generated depending on a few choices, like the type of the boiler, the energy carrier, etc. The HVAC system consists of controls and emissions, distributions, storage, and generation, but the actual parametrization is hidden to keep the user interface simple. The wizard runs automatically, so if the conditioning is changed, e.g., the cooling is added in a zone, then the wizard automatically creates and links a cooling system. The calculation does not use fixed efficiencies of the systems but calculates the actual energy losses of all parts of the HVAC system. As a result of the analysis, the efficiencies of the systems can be shown and compared to national requirements. The energy auditors may be interested in the details of

the HVAC system. By switching to the expert's mode, the details of the wizard's parametrization are revealed, and they can be edited in much greater detail.

Energy auditors may want to look at measures to improve the energy efficiency of the building. The software offers a database of energy efficiency measures, which can be combined with various packages of energy efficiency measures. These measures are applied in the consumption calculation, but they are also mentioned in the EPC as possible measures to improve the energy efficiency of the building.

In addition to the final results, MEEC software can display intermediate results throughout the data entry process, thus allowing the user to continuously keep track of the impact of specific input parameters on the calculation results.

By finalization of the MEEC software and the register of issued energy performance certificates, a scheme for energy certification of buildings will be completed. It is expected that process of building certification will start form 2023.

The remaining obligation from EPBD is related to the development of the **Long-term building renovation strategy**, which is planned to be completed through the preparation of a dedicated Study on the improvement of the energy efficiency of buildings in Montenegro (obligation under the Law on Efficient Use of Energy (from 2019)). The Ministry of Capital

Investments has assisted the Government of the Federal Republic of Germany, through KfW bank, develop this vital document.

The building renovation strategy aims to develop the investment environment for improving the energy performance of the overall building stock in Montenegro. According to the Law on Efficient Use of Energy, Strategy should contain the following elements:

- Review of the building stock;
- review of cost-effective energy efficiency measures for buildings, depending on the type and purpose of the building and climatic conditions;
- review of incentive measures for financing works on buildings reconstruction and/or renovation to improve their energy performance;
- long-term projections for facilitating investments in energy efficiency improvement of buildings by individuals, the construction industry, and financial institutions;
- estimation of expected energy savings and other benefits.

Finalization of the Strategy is planned for the beginning of 2023.

2.2. Energy labeling and eco-design of energy-related products

Many energy-related products (appliances and equipment) have a significant potential for being improved to reduce environmental impact and achieve energy savings through better design. Improvement for many energy-related products is ensured through eco-design regulations and energy label regulations.

Eco-design regulations set the minimum energy performance and environmental criteria for energy-related products. Products must comply with these criteria to bear a CE mark and be available for sale.

Energy Labelling regulations provide consumers with information about the product's environmental impact. Products for sale should have a prominent label with an indicated energy efficiency class. Consumers are familiar with the energy label and consider the energy rating when choosing which product to buy.

Figure 3: Design of CE mark for eco-design and energy label

Montenegro is obliged to regulate the placing on the market energy-related products, aiming to reduce their negative impact on the environment. The first step is establishing the legal framework and introducing a scheme defining concrete obligations for market actors (suppliers and dealers).

The legal basis was provided in the Law on Efficient Use of Energy. In the previous period, more than 40 by-laws introduced eco-design requirements and energy labeling for different groups of products. A more detailed overview of the status is given in Table 2.

Table 2: Overview of the by-laws regulating placing on the market of energy-related products

Eco-design requirements	**Energy labeling**
EU acquis: – Directive 2009/125/EC establishes a framework for the setting of eco-design requirements for energy-related products – Accompanying regulations (implementation measures) for specific groups of products;	EU acquis: – Directive 2010/30/EU on energy labeling of energy-related products – Accompanying regulations (implementation measures) for specific groups of products;
Harmonization: **15 by-laws have adopted** regulation eco-design requirements for lighting technologies, washing machines, dishwashers, refrigeration appliances, televisions, air-conditioners, space heating, water heating technologies, cooking devices, etc.	Harmonization: **29 by-laws adopted** so far regulating energy labeling of lighting technologies, washing machines, dishwashers, refrigeration appliances, vacuum cleaners, air-conditioners, space heating and water heating technologies, ventilation units, cooking devices, computers and servers, motors, transformers, water pumps, etc.

In parallel with the adoption of regulations, the Government has organized activities on capacity building of market inspections to control the application of the prescribed obligations.

Implemented activities resulted in a ban on placing on the market specific inefficient products/technologies (i.e., incandescent bulbs, on/off air-conditioners) and created different

benefits in terms of energy and cost savings, as well as in terms of environmental protection. Citizens benefit directly from introducing new rules for energy-related products, bearing in mind that most household appliances are subject to eco-design regulations such as heating/cooling technologies, lighting, food preparation, hygiene (washing and drying machines, dishwashers, vacuum cleaners), etc. Although purchasing more efficient devices often means significant initial investment for citizens, the price difference is compensated during the product's lifetime through achieved energy savings.

An essential aspect in implementing the energy efficiency policy related to eco-design and energy labeling of the product is an information campaign to raise the awareness of suppliers and distributors, but also of citizens, as the end users of these products.

2.3 Energy management in the public sector

Law on Efficient Use of Energy stipulates the obligation of energy management to state administration bodies, local self-government units, public services established by the state or local government, and significant energy consumers. The Law also stipulates sanctions in case of failure to meet this provision.

In the previous period, the Ministry of Capital Investments adopted rulebooks which are support performing energy management, as follows:

1. Instruction on energy efficiency measures with guidelines for their implementation ("Official Gazette of Montenegro," 73/15 of 23 December 2015);

2. Rulebook on information systems of energy efficiency and on the manner of submission of data ("Official Gazette of Montenegro," 73/15 of 23 December 2015);

3. Rulebook on the content of the energy efficiency improvement program and energy efficiency improvement plan of the local self-government unit and the report on the implementation of the plan ("Official Gazette of Montenegro," 73/15 of 23 December 2015);

4. Regulation on methodology for determining annual consumption of primary energy, the content of the energy efficiency improvement plan, and the report on the implementation of the program of big consumer ("Official Gazette of Montenegro," 73/15 of 23 December 2015);

5. Rulebook on methodology for determining energy savings ("Official Gazette of Montenegro," 22/16 of 31 March 2016).

Concrete results in the establishment of energy management have not been achieved, primarily due to inconsistent performance of the Law by the obliged parties. That was the reason for significant improvement of the concept of energy management by the Amendments to the Law on Efficient Use of energy from 2019, particularly with regards to:

- A more precise definition of the legal requirements, procedures, rights, and obligations of public sector entities regarding the establishment of the energy management system to systematically plan, implement, and monitor the energy efficiency measures, as well as reporting on the achieved results;

- Abolishing the obligation for public sector entities to establish their energy efficiency information systems and introducing the obligation to submit data on energy and water consumption to the Central energy efficiency information system;

- Introduce the obligation to establish centralized reporting on implementing energy efficiency measures and energy savings achieved by all entities recognized by the Law.

The legal basis for implementing the energy management system in practice has been significantly improved by upgrading the regulatory framework.

- The energy management concept was prepared under the support of KfW. It represents a framework for systemic and efficient management of all policies, processes, and procedures related to energy efficiency improvement in the public sector. This concept is adjusted to three institutions responsible for buildings reconstructed under the EEPPB project (Ministry of Education, Ministry of Social Welfare, and Property administration). The concept related to maintaining facilities under the competence of the institutions mentioned above is being drafted simultaneously. This concept shall stipulate regular procedures which are to be implemented to keep the buildings in an operational and proper state for a more extended time;

- The Ministry of Capital Investments has developed a software platform for monitoring and verification (MVP) in cooperation with GIZ and its Open Regional Fund – Energy Efficiency (ORF-EE). The platform aims to support the evaluation of the energy efficiency policy implementation by calculating achieved energy and financial savings and reducing greenhouse gas emissions. MVP platform is operational, training of future users (energy managers in the state administration bodies and local self-government units) was conducted in 2020/2021, and it is planned to be used as an official tool for monitoring and verification of energy savings;

- The training program for energy management, consisting of 7 modules, was successfully implemented in close cooperation between the Ministry of Capital investment and the

Mechanical Faculty of the University of Montenegro. Due to the situation, the vid COVID-19 pandemic training program lasted longer than planned. Around 30 representatives of state administration bodies and local self-government units participated in the training. The plan is to continue the activities related to energy managers' capacity building in the future.

- The Ministry of Capital Investments has provided support from KfW bank for developing a Central information system for energy efficiency to monitor energy and water consumption in public sector buildings. Implementation of this project started in 2021. The first version of the information system is available; the whole operation is expected in 2023 after the completion of testing and capacity building of future users (energy managers in the state administration bodies and local self-government units);

Central information system for energy efficiency (CISEE)

The Ministry of Capital Investments, as the authority responsible for energy efficiency policy, is obliged to establish a Central information system for energy efficiency (CISEE) to monitor energy and water consumption in public facilities, for which the costs are paid from the state budget or the budget of local self-government units.

The information system enables monitoring on two levels:

- *The basic level* is implemented based on data taken from the database of energy and water suppliers. This level of monitoring will be implemented for all 2,500 public facilities in Montenegro.

- *Advanced level*, which is implemented based on energy and water consumption data, and on the level of comfort from measuring devices installed in buildings. This level of monitoring will be implemented for about 250 public facilities.

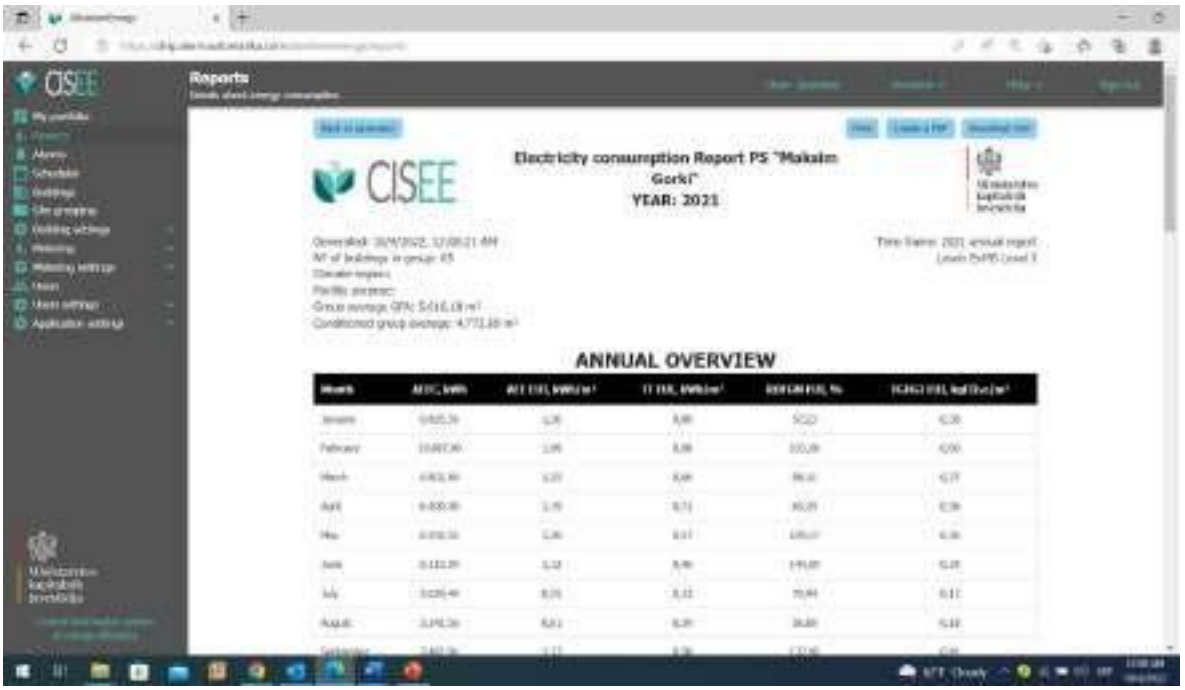
CISEE aims to establish a reasonable basis for assessing the energy performance of public buildings, identify possibilities for improving energy efficiency and rationalization of energy consumption, and enhance building maintenance.

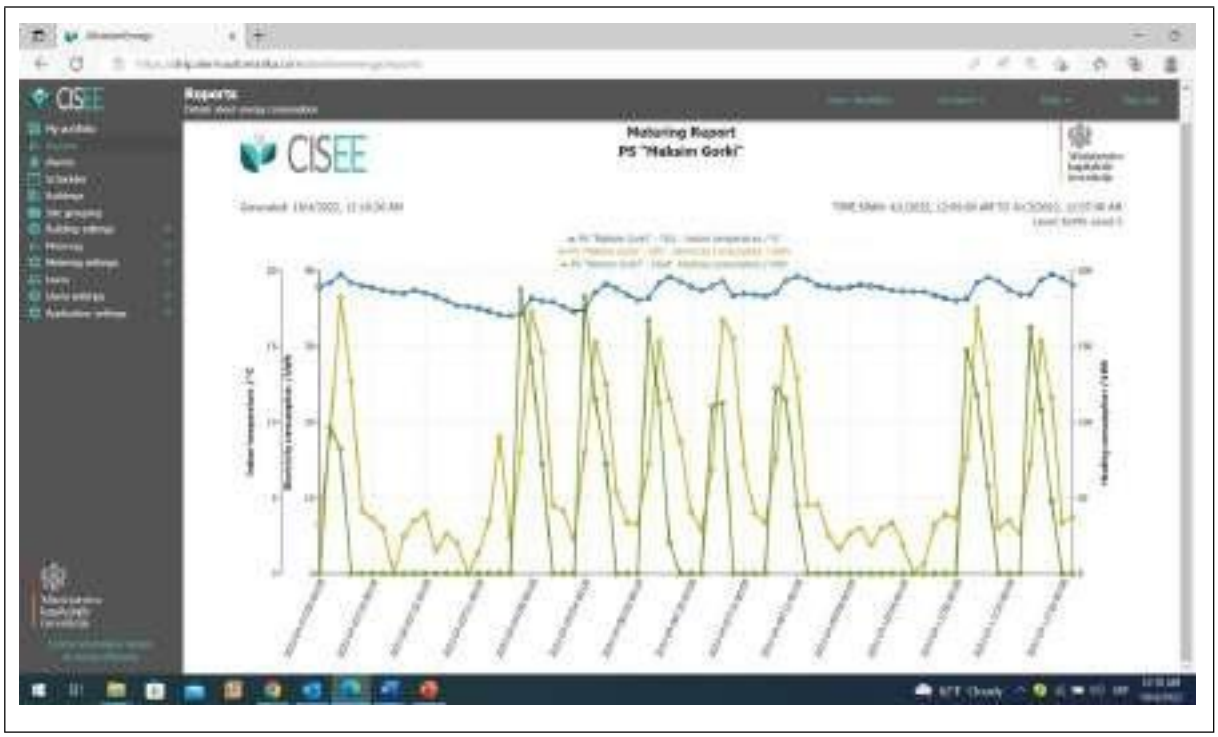
The backbone of CISEE is a software application dedicated to monitoring energy consumption (electricity and fuel) and water. This tool is characterized by modularity and scalability, making it a practical solution for the future increase in the number of objects to be monitored, depending on the user's needs. The software application is developed as a

web solution, it does not require installation on a computer, and access is enabled through user credentials for each user.

Reporting module represents one of the most critical functionalities in the software application. Via Reporting module, the user receives different reports on energy consumption, as well as on the current conditions the in the facility (temperature, CO2 levels). The final reports can be generated in three ways depending on the monitoring level which is implemented in the concrete facility:

1. from monthly bills or manual entry,
2. from measuring equipment,
3. as a generic report in tabular form.

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