Energy Efficiency Finance II

Task 1 Energy Efficiency Potential

FINAL Country Report: Montenegro

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Abbreviations

EAR	European Agency for Reconstruction
EE	Energy Efficiency
EEAP	Energy Efficiency Action Plan
EPB	Energy Performance in Buildings
EDS	Energy Development Strategy of Montenegro by 2030 – Green Book
EnCT	Energy Community Treaty
EnCS	Energy Community Secretariat
ENSI	Energy Saving International AS (Norwegian Company)
EPCG	Montenegrin State Electric Power Company (Elektroprivreda Crne Gore)
EPS	Serbian State Electric Power Company (Elektroprivreda Srbije)
GIZ	German International Cooperation
HPP	Hydro Power Plant
IFI CO	International Financial Institutions Coordination Office
IPA	Instrument for Pre-Accession Assistance
KAP	Aluminum Plant Podgorica (Kombinat aluminijuma Podgorica)
LFO	Liquid Fuel Oil
ME/DEE	Ministry of Economy/Directorate for Energy Efficiency
RE	Renewable Energy
UNECE	United Nations Economic Commission for Europe
SFRY	Socialist Federal Republic of Yugoslavia
sHPP	Small Hydro Power Plant
TPP	Thermal Power Plant
VAT	Value added tax

1 Executive Summary

Energy efficiency is one of the priorities of the new Energy Policy (2011) in Montenegro and more broadly in the region of South-East Europe and the EU. Its importance continues to grow in an environment of i) high dependency on energy imports, ii) rising energy prices, and iii) concerns about security of energy supply and climate change.

Energy efficiency is recognised as a cost-effective and fast way to increase the security of energy supply and reduce the greenhouse gas emissions responsible for climate change. Making the economy more energy efficient will also have positive impacts on economic growth and job creation.

Energy efficiency is of utmost importance for Montenegro where energy demand is heavily imbalanced. **Two energy intensive industrial companies**, the Aluminum Plant Podgorica (KAP) and the Steel Works Plant in Niksic **consumed about 45% of the total final energy consumption** of the country and 50% of the final electricity consumption of the country in 2008[1].This fact considerably affected the energy intensity indicators of the country that appear to be from 6 to 8 times higher than the EU average. The high energy intensity is also influenced by the low energy efficiency in other industrial sectors, which is mainly caused by outdated technology and slow adoption of new technical solutions and technologies. According to latest figures, energy consumption in industry totals around 8 PJ, which is 29% of TFC (28 PJ in 2011). From these figures, more than 80 % are still attributable to the non-ferrous metals sector.

Apart from the industrial sector, **transportation** is also a significant energy consumer contributing to about **30 % of the final energy consumption** in 2011 and with significant unexploited EE potential.

Households, commercial, and public buildings consumed about 40% of the final energy consumption in 2011 and they are characterised by poor energy performance in construction and technical systems, deficient maintenance, and low levels of awareness among energy consumers. Additionally, the **lack of natural gas** and the **low, subsidised electricity prices** in the past resulted in an **excessive direct use of electricity for space heating and for production of sanitary hot water**. Also, air conditioning split-units, which are commonly used in Montenegro, especially in the southern part, are characterised by poor quality and improper maintenance. District heating has been neither developed, nor adequately studied, despite the fact that the climatic conditions and biomass availability, particularly in mountainous (northern) regions of Montenegro, may be favorable for such solutions. Instead of that, northern households **burn wood, mainly high quality wood** from industrial processing, in domestic stoves. The problems associated with this practise are the low efficiency level and the large portion of wood residue from the wood processing industry not further used or processed for the production of modern biomass fuels (pellets and briquettes). Moreover, **solar thermal systems are rare**, even in coastal areas where solar potential is abundant, and in the last decade demand for sanitary hot water has dramatically increased during the **summer tourist season**. Additionally, it is necessary to have in mind that increasing numbers of buildings constructed in the past few years feature some type of thermal insulation but without sufficient consideration to their energy performance. The **building codes adopted in 2013 represent the first step** in establishing a framework to improve the quality of the buildings' construction, respecting the principles of energy efficiency.

Despite the economic crisis in 2008/2009 the energy consumption in the household and service sector remained at the same level. This indicates that energy saving potential in the household and service sector is quite constant and hardly can be influenced by outside factors (e.g. economic, political). A similar situation can be found in the transport sector.

[1] 2008 is used as a reference year because both large industrial plants (KAP and Steelwork Niksic) were operational. In the last few years both companies were privatised, the number of employees was significantly decreased and their production was reduced. The future of these plants is uncertain, especially due to the fact that both of them are using outdated technology (constructed 40 years ago) and it is hard to believe that the private owner will invest in completely new, more efficient technology.

The main share of **SMEs** belongs to the trade sector. Thus the main energy saving potentials for SMEs can be expected in energy savings related to buildings and transportation. In some sub-sectors e.g. manufacturing of food products, beverages and tobacco some energy efficiency potential can be expected.
Energy consumption in the agriculture sector is relatively low in comparison to other sectors. Along with electric and thermal energy, the consumption of motor fuels (mostly diesel fuel for tractors) is dominant in this sector.

The main driving force for the promotion of EE in Montenegro is its participation as a Contracting Party to the EnCT. Since December 2009 the Ministerial Council of the **Energy Community** officially decided on the adoption of certain key EU Directives on EE. In response to this Decision, the Parliament of Montenegro accepted the **Law on Energy Efficiency in 2010** that provides a legal basis and gives a significant boost to the promotion of EE.

Due to the significant change of the EU *Acquis* in the field of energy efficiency, Montenegro updated the law in the field of energy efficiency – Law on Efficient Use of Energy, which was adopted by the Parliament in December 2014.

According to the Law, the EE policy and the activities to improve EE are implemented through 3-year EE Action Plans.

Energy savings **until 2020 are expected to reach about 2 PJ** with focus on the transport and residential sector and will be linked to **private investments in the range of 266 million EUR** and public investments of 82 million EUR.

2 Aim and Scope of this Report

The Development Bank of Austria (OeEB) aims to increase its activities in the field of energy efficiency in selected countries via dedicated credit lines, but also via supportive programmes for selected financial institutions and project developers, and also analyse the options for direct financing. The present study is part of the overall study, which analyses the status of energy efficiency in the countries of Serbia, Bosnia and Herzegovina, Albania, Montenegro, and Georgia.

The Study is carried out in cooperation of ALLPLAN GmbH and Frankfurt School and is based on the latest available information collected directly in the country by local experts in March 2015.

This report focuses on Task 1, “Potential of the Energy Efficiency Market” in Montenegro and analyses the following questions:

- What is the Status of Energy Efficiency in each economic sector?
- In which sectors is the efficiency potential the highest and which companies are active in these sectors?
- What are the countries’ frameworks for energy efficiency - in terms of legal, economic, and technical aspects?

3 Studies Available

3.1 Overview

The topic of energy efficiency in Montenegro is elaborated through a number of documents (studies, strategies, etc) prepared by international and national institutions. The more up-to date and comprehensive ones, which were largely referred to in the preparation of this Report, are present in the table below. Having in mind the fact that the updated Energy Development Strategy of Montenegro by 2030 was developed in 2012/2013 and adopted by the Montenegrin Government on July 2014 it will serve as a main source of data regarding energy consumption, energy indicators, as well as relevant information regarding plans for future development in the energy sector.

Table 1: Overview of available reports

Name/Author/Date/Link	Purpose/Scope	Brief description
Energy Efficiency Action Plan for the period 2013-2015 (ME/DEE supported by GIZ-ORF, 2013) http://energetska-efi-kas-nost.me/uploads/file/Dokumenta/Energy%20Efficiency%20Action%20Plan%20for%20the%20period%202013-2015_final.pdf	Main planning document in the field of energy efficiency	Action Plan specifies: • national indicative energy savings target for the period of three years, pursuant to the indicative targets set forth in the Strategy; • energy efficiency measures to achieve the indicative target and methodology of their implementation; • timeframe dynamics for implementation of measures to achieve the indicative target; • assessment of the progress made in achieving targets in the period prior to Action Plan and • estimation of the resources needed for implementation of the Action plan, as well as the sources and methods for their securing.
Energy Development Strategy of Montenegro by 2030 – Green Book (Exergia member of COWI consortium; funded by EU, 2013) http://www.seaeds.me/images/120627_Output_3-1_Green_Book_final_draft_ENG.pdf	Main strategic document in energy field of energy	Energy Development Strategy specifies: • long-term development objectives and guidelines for development of supply and for meeting energy demand while taking into account technological and economic criteria and environmental protection criteria; • developmental orientations for energy infrastructure and mechanisms to encourage use of renewable energy sources and increase energy efficiency; • long-term projection of total energy balance of the country, timing and methods to be used in achieving and monitoring of development objectives, as well as assessment of their effects; • other objectives and elements of importance for establishment and implementation of the energy policy in accordance with the Law; • tentative financial resources for implementation of the Strategy.
Financing Energy Efficiency Investments in the Western Balkans (IFI CO, May 2013) http://www.wbif.eu/documents/275	Financing Energy Efficiency in the Western Balkans: Albania, Bosnia and Herzegovina, Croatia, FYR Macedonia, Kosovo, Montenegro, Serbia, Western Balkans	The summary guide to financing facilities for energy efficiency in the Western Balkans is intended to provide an overview of the range of financing facilities and technical assistance currently available in the region funded by International Financial Institutions (IFIs) and the European Commission (EC). It also highlights some key issues arising for the future development of such valuable sources of investment funds for this increasingly important policy area. The guide is based on a more detailed paper “Review of financial support facilities for energy efficiency and renewable energy in the Western Balkans and Turkey” published in June 2011. Figures were updated in March 2013.
Energy Efficiency in Buildings in the Contracting Parties of the Energy Community **(ENSI supported by EnCS, 2012)** https://www.energy-community.org/portal/page/portal/0633975AB8067B9CE053C92FA8C06338	A comprehensive overview of status of implementation of the Building Directive in the Contracting Parties of the Energy Community.	The main aim of the study was to support the Contracting Parties in their efforts to meet their obligations under the Energy Community Treaty. The study gives a comprehensive overview of status of implementation of the Building Directive in the Contracting Parties. It also tries to facilitate the Parties' future efforts in preparation of EEAPs and to change attitude toward energy consumption in buildings. The report gives guidelines for preparing inventory of buildings and defining reference building for each category as defined in the EPB Directive. The study also provides instructions for developing a common methodology for national database for climate parameters and calculation of the energy performance indicator of buildings. Finally, it provides a model for assessment of potential energy savings, as well as, for calculation of needed investments.

National Action Plan of Montenegro for Energy Efficiency Measures in the Residential Sector (UNECE, 2012) http://www.unece.org/fileadmin/DAM/hlm/documents/Publications/ee.ap.montenegro.pdf	Support for governments in UNECE region to increase energy efficiency in the housing sector and to address economic and environmental challenges more effectively at the national level	It aims at assisting the Government of Montenegro in enhancing its energy-efficiency policy for residential buildings through: • Assessing the existing legal and institutional framework for energy efficiency in the housing sector. • Identifying institutional/legal impediments, as well as priority areas for action. • Recommending detailed actions for improving energy efficiency in the residential sector.
Review of Financial Support Facilities Available for Energy Efficiency and Renewable Energy in the Western Balkans (IFI CO, June 2011) http://www.wbif.eu/documents/25	Review of Financial Support Facilities for Energy Efficiency and Renewable Energy in the Western Balkans	The overall objective of the Report is to provide information and analyses on the various financial support mechanisms funded by the European Commission (EC), International Financial Institutions1 (IFIs) and bilateral donors, to promote energy efficiency in the Western Balkans.
Energy Efficiency Strategy of Montenegro (Expert team from the University of Montenegro supported by expert engaged by the EAR, 2005) http://energetska-efikas-nost.me/uploads/file/Dokumenta/Energy%20Efficiency%20Strategy%20of%20Montenegro.pdf	Main strategic document in the field of energy efficiency	The main objective of the Energy Efficiency Strategy is to emphasize on the impact of the rational use of energy on security of supply, market competitiveness and the environment. The Energy Efficiency Strategy presents the framework initiatives needed for the promotion of energy efficiency in all energy sectors in Montenegro, especially in the final energy consumption sector, including initiatives for increased use of alternative and renewable resources.

3.2 Main results of existing studies

Most of the presented documents (strategies, studies, etc) recognise the building sector as a main energy consumer. Heat losses of newly constructed buildings can be defined by introduction of new standards of construction. However, reduction of heat loses of the existing building stock is the most difficult task, but also represents the greatest potential for action. The documents presented in Table 1 provide different approaches to estimate the energy-saving potential in buildings in all relevant sectors: residential, public, and commercial.

Energy consumption of other companies in the processing industry, apart from KAP and Steelworks, is rather low, so the presented documents do not deeply analyse the energy potential in this sector (e.g. per industry branches). Also, due to the uncertain future of KAP and Steelworks, possibilities to introduce some of the measures in these production facilities are questionable and are not elaborated.

A similar situation exists with the agriculture sector which also has a low share of the total final energy consumption.

The transportation sector is also not adequately targeted in the presented documents. However, the Ministry of Economy intends to implement a separate project with a focus on estimating the potential for EE improvements and wider use of the RES in the transportation sector, which will be financed through IPA funds. The start of the project is planned for April 2015.

4 Status of Energy Efficiency

4.1 Energy supply

IMPORTANT NOTE: Figure 1 (Source: IEA website) gives an easy to read overview of the energy flows in Montenegro but some of the presented figures (values) should be taken as indicative only. A cross-check of the energy balances from the IAE website and the energy balances from the Energy Development Strategy of Montenegro by 2030 shows significant differences and deviations between these two sources of data. In the opinion of the Consultant, energy balances from the Energy Development Strategy of Montenegro by 2030 (EDS) offer more accurate and reliable data so they will be used as the main source in this Report. Unfortunately, the EDS energy balances cover only the period 1997-2010. Additional data for the final energy consumption side were provided by the Ministry of Economy for 2011 and presented in chapters 4.2-4.5. Bearing in mind that the situation in the energy sector in the last two years has not changed significantly, the opinion of the Consultant is that presented data for 2010 and 2011 are still valid and could be used for the current analyses.

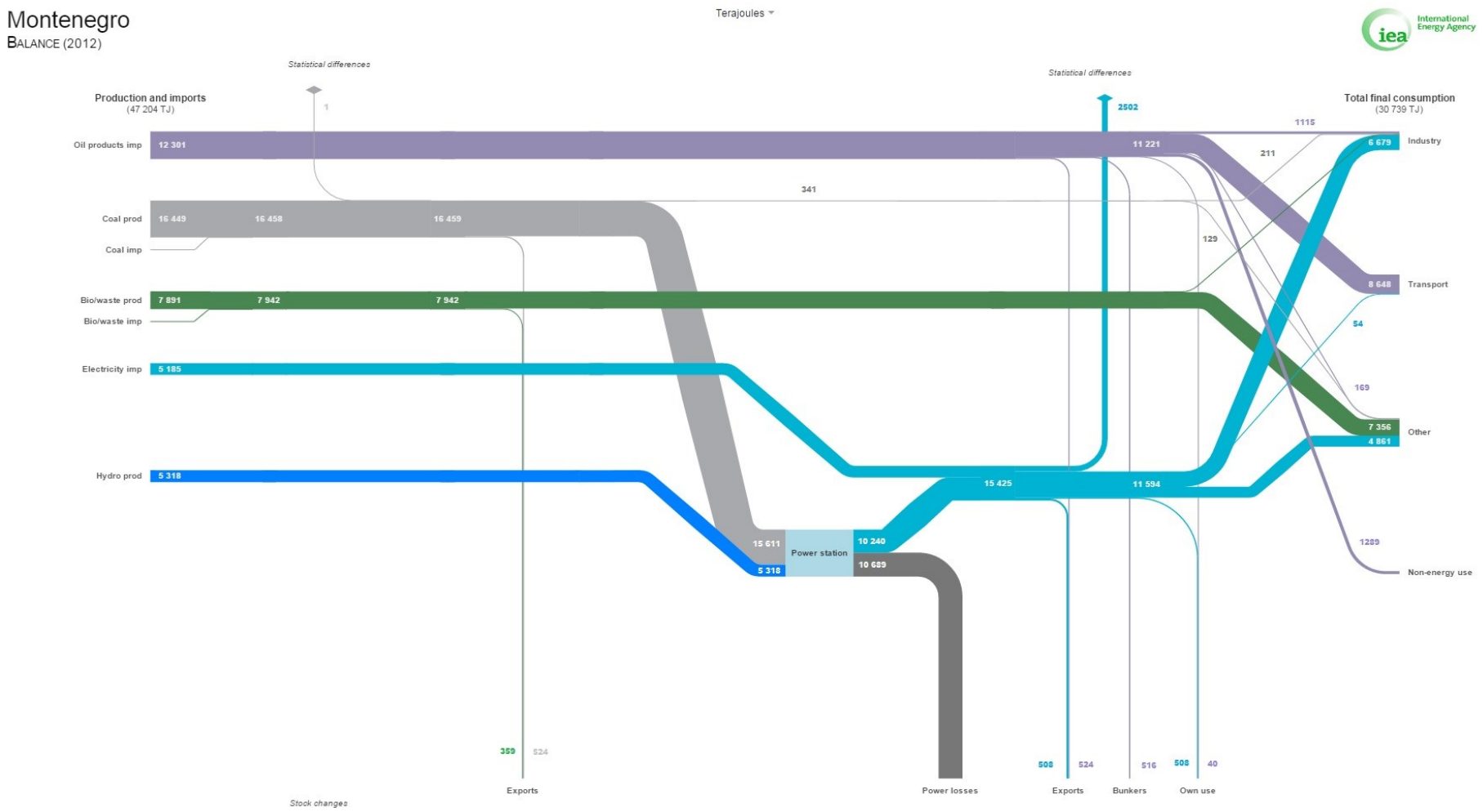
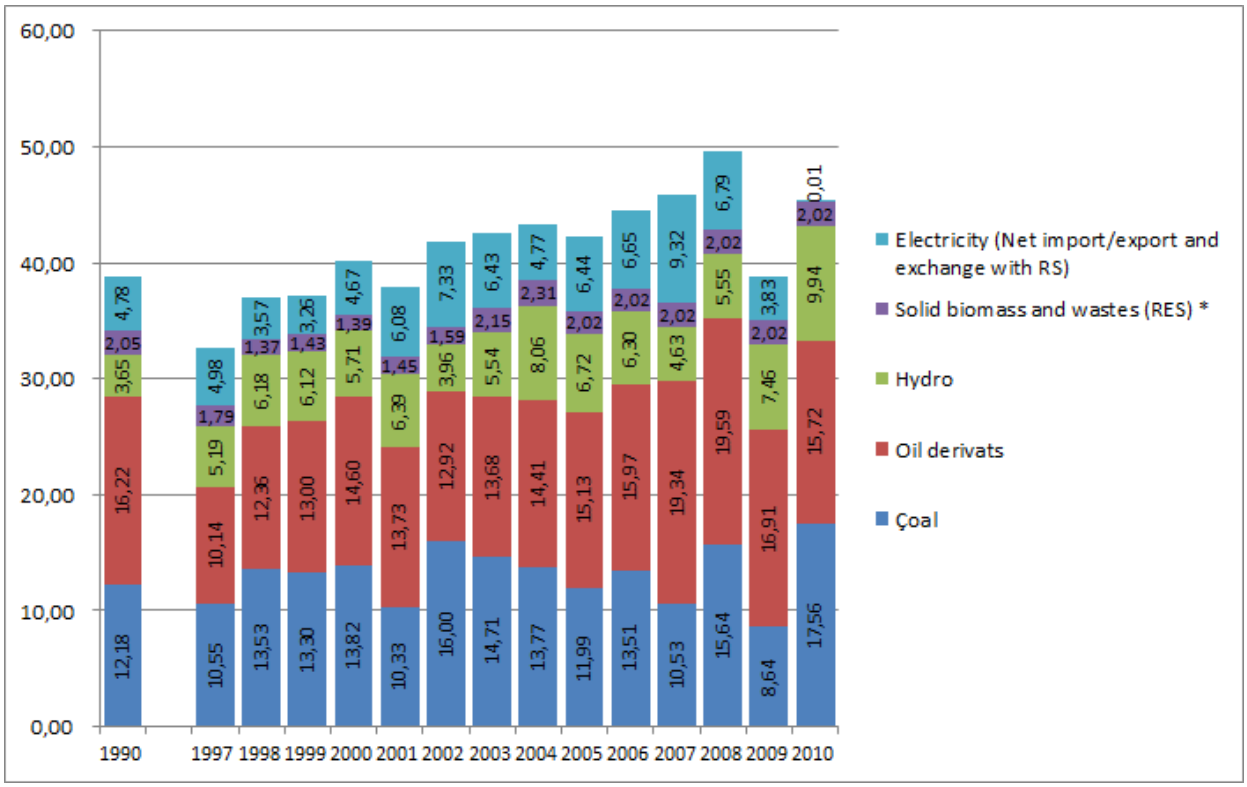


Figure 1: Final energy consumption in Montenegro in 2012 in TJ,

(Source: IEA, http://www.iea.org/Sankey/index.html#?c=Montenegro&s=Balance) Values inserted by ALLPLAN

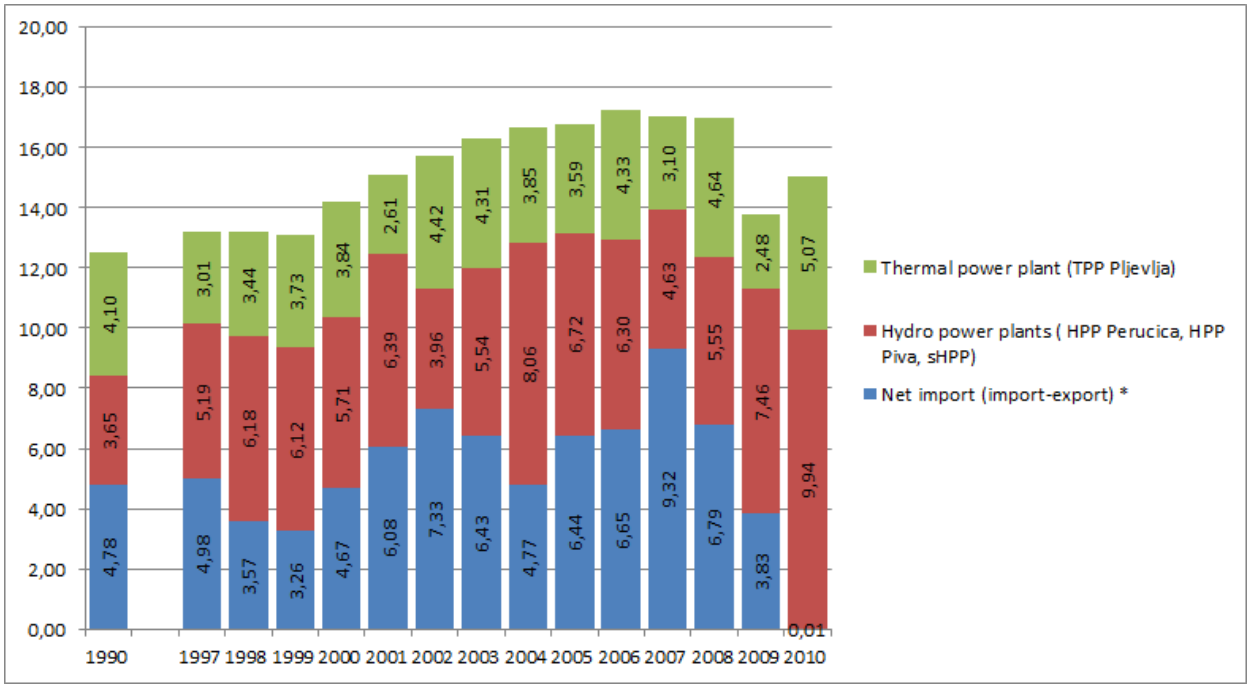
Figure 2 shows gross domestic energy consumption by source (primary production and imports). Depending on the observed year, the share of petroleum products together with solid fuels (coal) can be approximately 70%, of which the share of imported petroleum products is about 35-45% and the share of domestic coal is 25-35%. Consumption of electricity from hydro power plants, which depends on the unpredictable hydrology, was 9.5-22% in the period 1997-2010, while the rest was imported (up to the max. of 2,588 GWh in 2007). It is assumed that the annual contribution of fuelwood and wood-processing by-products was constant in that period of time (about 2 PJ or 4-5% of gross domestic energy consumption).



**) woody biomass, forest residues, waste form prim. woody industry, energy crops, agricultural by-products (crop and livestock residues) - all RES*

Figure 2: Gross domestic consumption of energy and fuel, 1990-2010 (PJ)
(Source: EDS, 2013)

Figure 3 shows the source of electricity supply in Montenegro from 1990 to 2010. And an average contribution of individual domestic power plants and imports in the supply is also shown. After many years during which Montenegro imported up to 35% of the required electricity, 2010 was the first year in which the balance of imports-exports, including exchange with the Republic of Serbia was almost zero. This occurred due to lower electricity consumption resulting from a reduction in KAP production and a peak in the generation of TPP Pljevlja and hydro power plants.



**) includes exchange of electricity based on EPCG-EPS contract on HPP Piva*

Figure 3: Gross electricity supply, 1990-2010 (PJ)
(Source: EDS, 2013)

The balance of electricity for the selected years is shown following the simplified EUROSTAT form in *Table 2.*

Table 2: Balance of electricity 1990-2010 (PJ)
(Source: EDS, 2013)

Simplified EUROSTAT form	1990	2000	2005	2008	2009	2010
Primary production + recovered products	-	-	-	-	-	-
Net import (import-export)	4.78	4.67	6.44	6.79	3.83	0.01
Stock change + international bunkers	-	-	-	-	-	-
Gross inland consumption	4.78	4.67	6.44	6.79	3.83	0.01
Transformation input	-	-	-	-	-	-
Transformation output	4.23	3.84	3.59	4.64	2.48	5.07
Production from RES (Hydro)	3.65	5.71	6.72	5.55	7.46	9.94
Consumption of the energy branch	0.50	0.51	0.54	0.64	0.42	0.67
Distribution losses	1.06	1.70	2.79	2.61	2.58	2.40
Available for final consumption	11.10	12.01	13.43	13.74	10.76	11.95
Final non-energy consumption	-	-	-	-	-	-
Final energy consumption	11.10	12.01	13.43	13.74	10.76	11.95
Industry	8.12	6.43	7.54	7.21	4.18	5.03
Transport	0.17	0.08	0.09	0.08	0.07	0.08
Other consumption	2.81	5.49	5.80	6.44	6.51	6.84
Households	*1.92*	*4.01*	*3.93*	*4.24*	*4.27*	*4.45*
Commerce and public services	*0.72*	*1.42*	*1.87*	*2.18*	*2.24*	*2.38*
Agriculture	*0.09*	*0.04*	*0.00*	*0.00*	*0.00*	*0.00*
Non-specified	*0.08*	*0.02*	*0.00*	*0.02*	*0.00*	*0.00*

Source: EB (2005-2010) energy database (Ministry of Economy)

According to the Energy Balance, the final electricity consumption in the period 1997-2010 was on the rise (1.93%/year from 3,091 GWh in 1997 to 3,816 GWh in 2008) but it grew slower than the gross energy consumption (3.86%/year in the period 1997 to 2008). With the decrease in Aluminum Plant Podgorica's (KAP) production and Niksic Steelworks in 2009, the final electricity consumption has fallen to only 2,989 GWh. Due to the excellent hydrological conditions in 2010 and above average generation in all HPPs (4,171 GWh gross generation) and also TPP Pljevlja (1,272 GWh), the power system of Montenegro, for the first time in the period after the 1990s, was able to provide enough electricity to cover the demand from its own resources.

The structure of gross production and the supply of electricity are presented in *Figure 4*. If we observe the average 5-year period the import/export, together with the energy exchange with the Republic of Serbia (based on the contract between EPCG and EPS on exploitation of HPP Piva), represented about 35% of all the electricity needs of Montenegro, the rest was covered by HPP Perucica (22.9 %), TPP Pljevlja I (22.1%), HPP Piva (19.5%) and small hydro (less than 1%).

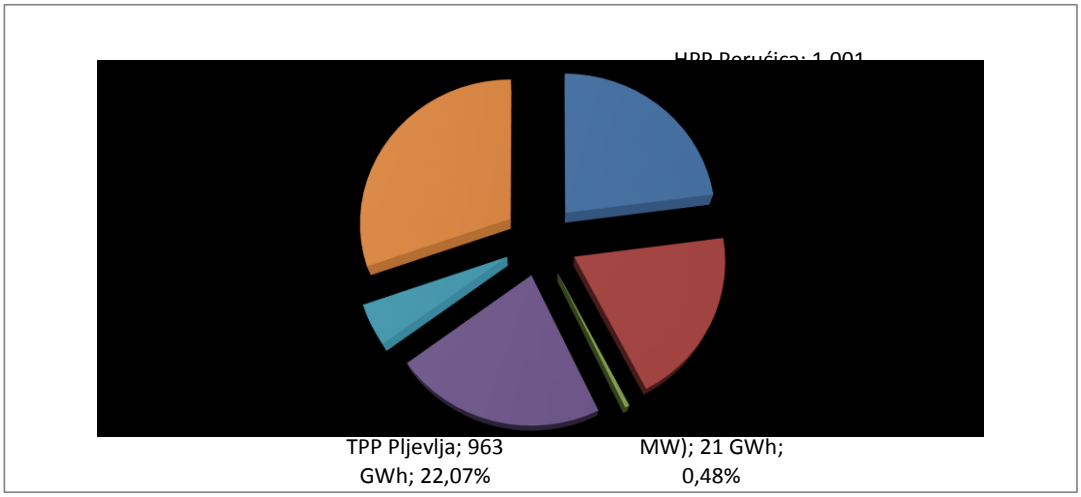


Figure 4: Structure of gross production and supply of electricity (average 2005-2010)

4.2 Energy demand

The total final energy consumption which is shown in *Figure 5*, for the period 1997-2011, also indicates a constant increase (average 3.74%/year, from 23.9 PJ in 1997 to 35.7 PJ in 2008). According to the consumption structure, there was a reduction in the consumption of KAP and Steelworks Niksic in 2009.

According to *Figure 5* and depending on the year, the industrial sector dominated (40-46%) followed by – households, services, etc. (29-36%), while the transportation sector represented 18-28%. With reduced consumption in the ferrous and non-ferrous metallurgy industry in 2009 and 2010, it can be observed that the transportation sector became the dominant sector compared to household, services. This sector has recorded a constant increase in consumption, indicating the important role of transportation in the final energy consumption in the future. According to latest figures, despite the economic crisis in 2008/2009 which created a significant negative impact on the industrial sector in Montenegro, the energy consumption in the household and service sector remained the same level and increased its share in overall TFC (approximately 28 PJ) to more than 40% in 2011. Industry accounted for less than 29% of TFC in 2011.

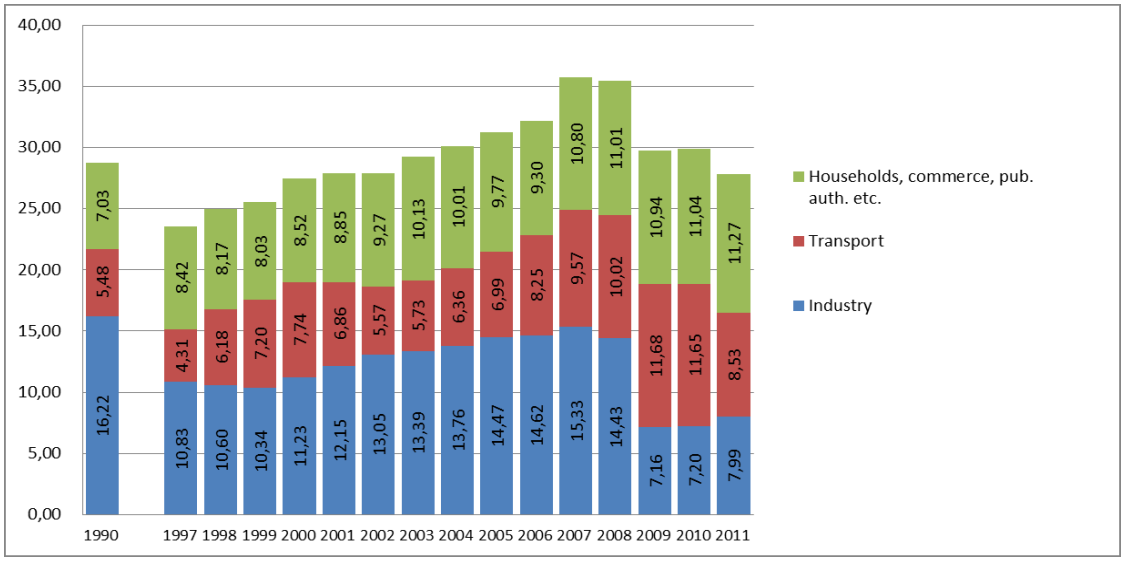


Figure 5: Final energy consumption by sector, 1990-2010 (PJ)
(Source: EDS, 2013)

The Energy Development Strategy of Montenegro by 2030 – Green Book analyzed different scenarios to forecast total final energy consumption, taking into account: GDP growth, implementation of the EE measures in consumption sectors, construction of the energy generation facilities, and sustainability of KAP."High scenario with measures" was chosen as the reference scenario in EDS and was used in this report as most probable scenario for forecasting the total final energy consumption and other relevant figures. Total final energy consumption according to the reference scenario by sector is shown in *Table 3* and *Figure 6* that show actual numbers for the period 2000-2010 and forecast by 2030. Final energy consumption in 2030 will be twice the figure in 2010 according to this scenario. In the structure of the future final energy consumption, there is a noticeable increase in the share of the transportation and industrial sectors, and stagnation of the share of households and services is observed.

Table 3: Actual (2000-2010) and forecasted total final energy consumption by sector by 2030 - Reference scenario (PJ)
(Source: EDS, 2013)

Sector	2000	2005	2008	2010	2015	2020	2025	2030
Industry	12.83	15.36	15.30	7.71	17.49	19.89	22.58	25.54
Manufacturing industry	*11.86*	*14.60*	*14.72*	*7.30*	*15.96*	*17.24*	*19.16*	*21.26*
Agriculture, non-energy mining and construction	*0.97*	*0.75*	*0.58*	*0.41*	*1.52*	*2.64*	*3.38*	*4.19*
Transport	7.74	6.99	10.02	11.64	14.33	16.42	17.84	18.78
Households	5.48	6.41	6.65	6.92	7.33	7.99	8.56	9.15
Services	2.27	2.66	3.82	3.75	4.95	5.74	5.92	5.95
Total	***28.32***	***31.42***	***35.79***	***30.02***	***44.10***	***50.04***	***54.90***	***59.42***

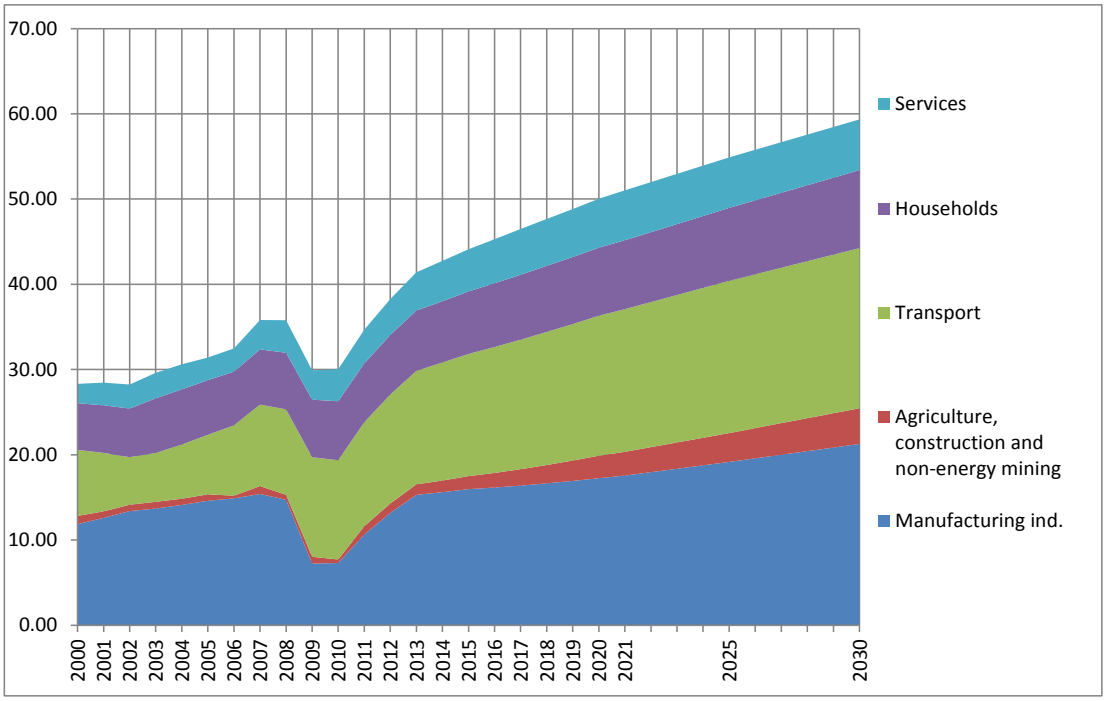


Figure 6: Actual (2000-2010) and forecasted total final energy consumption by sector by 2030 - Reference scenario (PJ)
(Source: EDS, 2013)

4.3 Greenhouse gas emissions

To prepare the Energy Development Strategy of Montenegro by 2030 – Green Book, a simulation model was used for calculation of CO_2 emissions, based on revised 1996 IPCC recommendations for calculation of national GHG inventories.

In the year 2008, CO_2 emissions amounted to 3.037 Gg. Biomass, which is considered CO_2 "neutral", was not included in CO_2 emissions. For that year, according to the sector structure, 51% of CO_2 emissions were caused by energy transformation (thermal power plants and public boiler rooms), 19% by industry, 24% by traffic and transportation, and 7% by other consumption. The structure of emissions in terms of fuels was 52% caused by coal and 48% by oil products.

Using the same methodology, calculated CO_2 emissions for the periods 1990 and 1997-2010 are shown in *Figure 7*.

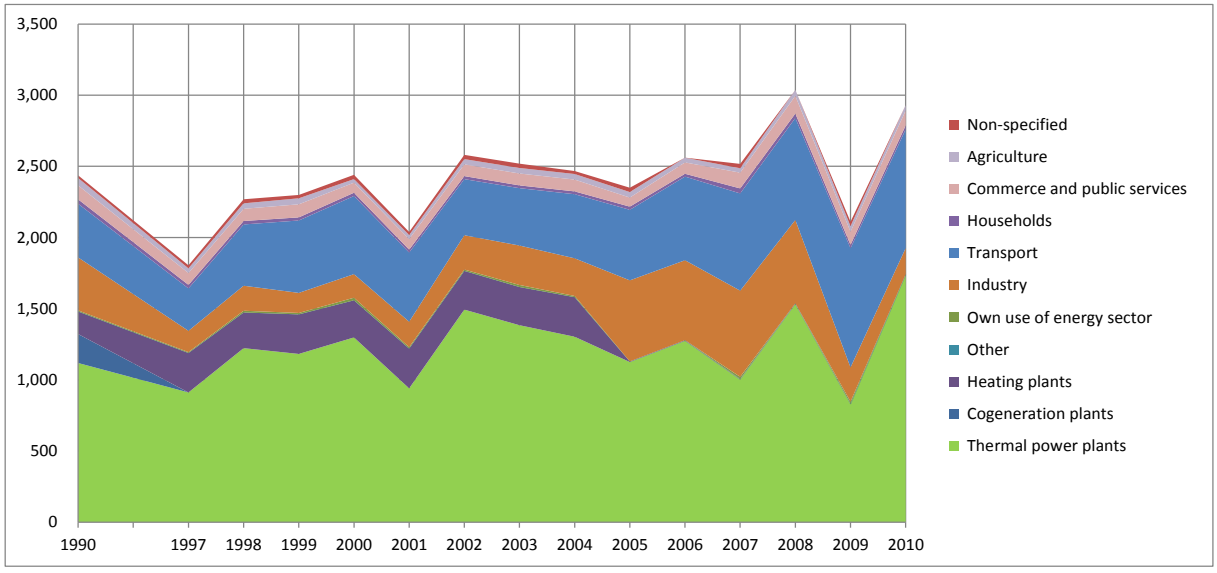


Figure 7: Emissions of CO_2 by sector, 1990-2010 (Gg CO_2)
(Source: EDS, 2013)

4.4 Energy efficiency in the industrial sector

4.4.1 Status of the industrial sector

Final energy consumption in the industrial sector increased in the period 1997-2008 (*Figure 8*), especially due to consumption in the non-ferrous metal industry, which represented 74-88% of total final energy consumption in the industry (*Figure 12*). In the period 2009-2010, energy consumption in the industry decreased by about 50% (14.4 PJ in 2008, 7.2 PJ in 2010) due to the reduced production of KAP and Steelworks Niksic. Consumption by the ferrous metals industry represented 6-14% of total final energy consumption of the industrial sector for the period 1997-2010. In this period, consumption of the ferrous and non-ferrous metals industry ranged from 6.6 PJ (2010) to 14.0 PJ (2007) and represented 87-94% of total final energy consumption of the industry.

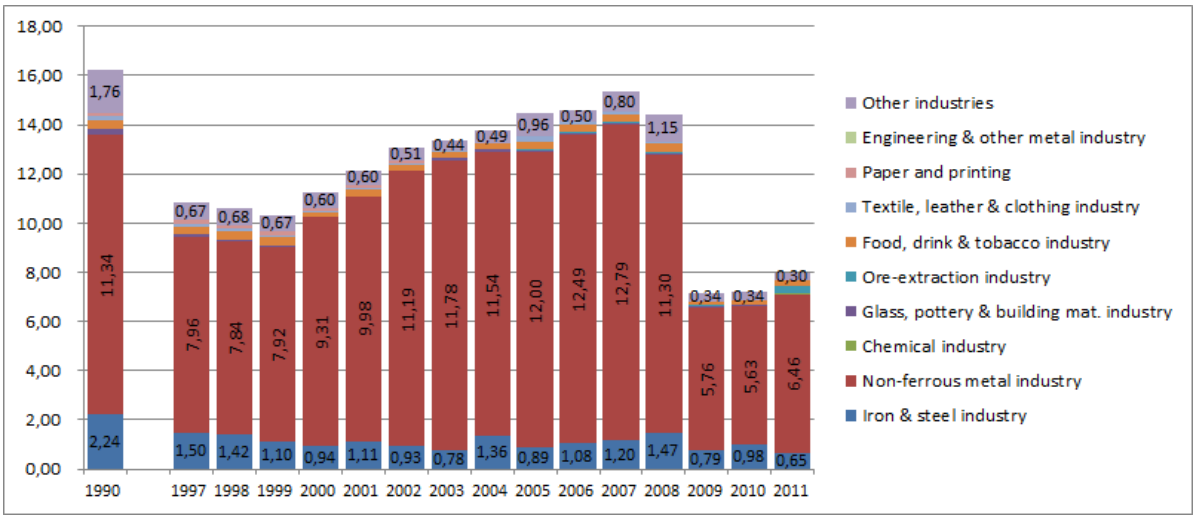


Figure 8: Final energy consumption by industry branch, 1990-2010 (PJ)
(Source: EDS, 2013)

If we analyse the data for the consumption of the processing industry sector (apart from KAP and Steelworks Niksic) for 2011, the most demanding two branches are: the ore-extracting industry and the food, drink, and tobacco industry (*Figure 9*).

The ore-extracting industry is mainly related to extraction of the metallic minerals: bauxite ore, lead, and zinc ore as well as non-metallic material for building construction: stone, travertine, cement marl, brick clay, gravel, sand etc.

Red bauxite exploitation is carried out by surface mining (open pits), and most pits were formed in the Niksic area. The depth of these pits is typically up to 100 m, and rarely reaches up to 150 m. The produced bauxite is further used by KAP for production of alumina (aluminum oxide) and aluminum. The company Bauxite Mines AD Niksic had a 20-year concession to exploit most of the bauxite reserves. However, due to difficulties in KAP production, the facility for production of alumina was closed and the company went bankrupt in 2012.

Lead and zinc ore mining is conducted in the northeast mountain region of Ljubisnja, Pljevlja (Suplja stijena). In 2006, the Company Gradir-Montenegro was granted a concession to explore and exploit deposits of lead and zinc in the Suplja stijena mine for a period of 20 years. In 2011, upon completion of additional research, preparation for the exploitation and construction of new facilities and equipment for the technological process of production of concentrates, an annual production of about 300,000 tons of ore was performed.

Montenegro is extremely rich in carbonate rock which is used as a technical-building stone. Various companies are involved in the extraction and processing of this material. For some of them, the production and sale of carbonate rock represents their main business, and for others the production is intended to supply their own demand of raw materials for the production of concrete, asphalt, and other construction needs.

Deposits of sand and gravel occur in alluvial sediments in the river beds of Cemovsko, Niksic, Grahovsko, and other karst fields. Some 1.85 million m^3 from the rivers in Montenegro and about 50,000 m^3 from fluvial-glacial sediments were extracted from these areas in 2007. After processing, gravel and sand are used as aggregate for concrete, asphalt, and other construction needs.

The food, drink, and tobacco industry is the next industry branch with significant energy consumption and the products with the largest share are the following:

- Food – meat and milk (mainly in northern regions of Montenegro: Niksic, Bijelo Polje, Danilovgrad), wheat flour (Podgorica and Niksic) and sea salt (Ulcinj),
- Drink – beer (beer factory Trebjesa in Niksic) and wine (Plantaze 13 Jul in Podgorica)
- Tobacco – cigarettes (Duvanski kombinat Podgorica).

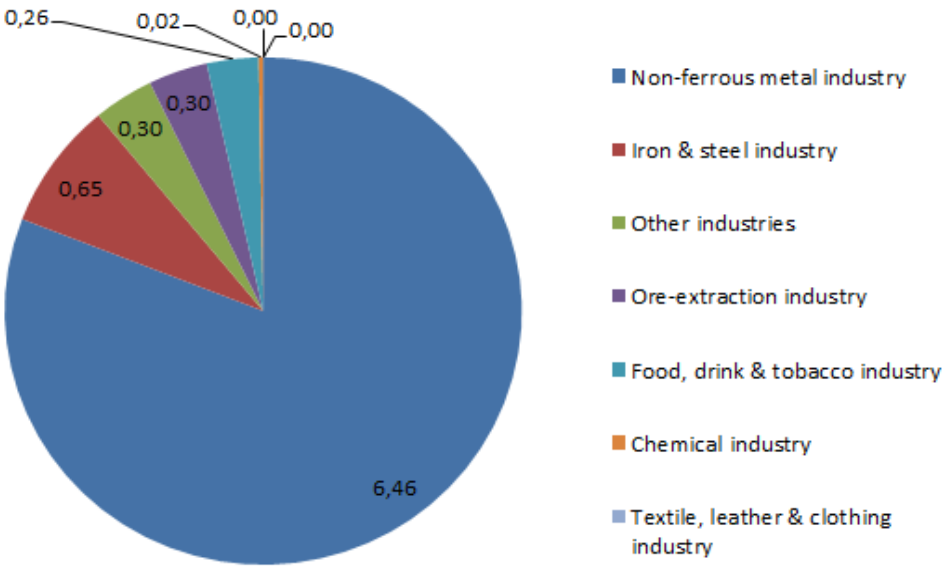


Figure 9: Final energy consumption by industry branch in 2011 (PJ)
(Source: EDS, 2013)

4.4.2 EE measures and future trends in industrial sector

In 2010, energy consumption in the processing industry of other companies, apart from KAP and Steelworks, was very small. Their electricity consumption was below 50 GWh.

Bearing in mind that there is no specific study dealing with the current situation in the industry sector (with a focus on energy) as well as with estimation of the savings potential for this sector, further analysis will be based on the EDS reference scenario[2].

The future of the two biggest industrial plants (KAP and Steelworks Niksic) is uncertain, especially due to the fact that both of them went through a privatising process in the past three years. Currently, both companies are using outdated technology (constructed 40 years ago) and it is hard to believe that the private owners will invest in completely new, more efficient technology. Therefore, possibilities to introduce some measures in these production facilities were not considered.

The processing industry apart from KAP and Steelworks will probably use new technologies, given that it is almost certain that private investors will be interested in investing. The energy intensity of industry in Montenegro (measured as energy consumed per unit of associated GDP) is comparable with most intensive transition countries. Those intensities are several times higher than intensities in the most developed European countries and are expected to decrease in the upcoming years. Decreasing energy intensity will be the result of structural changes, introduction of more efficient technologies in industrial

[2] Energy Development Strategy of Montenegro by 2030 – Green Book analysed different scenarios for forecast of total final energy consumption taking into account: GDP growth, implementation of the EE measures in consumption sectors, construction of the energy generation facilities, sustainability of KAP. “High scenario with measures” was chosen as reference scenario in the Energy Development Strategy.

processes, and above all, more competitive products with higher added value which reach higher prices on the market.

One of the implemented measures in the processing industry is to encourage the use of industrial wood waste, in addition to fossil fuels, as fuel for cogeneration. It has been estimated that by 2030, 15% of average-temperature heat will be generated from industrial cogenerations, but also that the share of biomass in cogeneration will reach 10%. Additionally, 1% of energy used for preparation of hot water will be generated from solar radiation (food industry).

Total savings potential in the industrial sector (excluding KAP and Steelworks Niksic) as a result of the EE measures estimated in the EDS reference scenario is 0.16 PJ in 2020 and 0.41 PJ in 2030, which corresponds to 2.5%-6.3% of 2011 consumption figures. Data for energy savings potential per industry branches are not available.

4.5 Energy efficiency in the residential sector

4.5.1 Status of the residential sector

According to *Figure 10*, the households sector, with a rather constant share of 60-65%, dominates in the consumption of final energy in sub-sectors of "Other Consumption" in the whole observed period 1997-2011. This is followed by consumption in the trade, tourism, and public services sectors with half the share corresponding to households (30-35%) while the share of agriculture is of 3-4%, depending on the observed year. The category Other Consumption shows an increasing trend of 2.9% annually over the period 1999-2011.

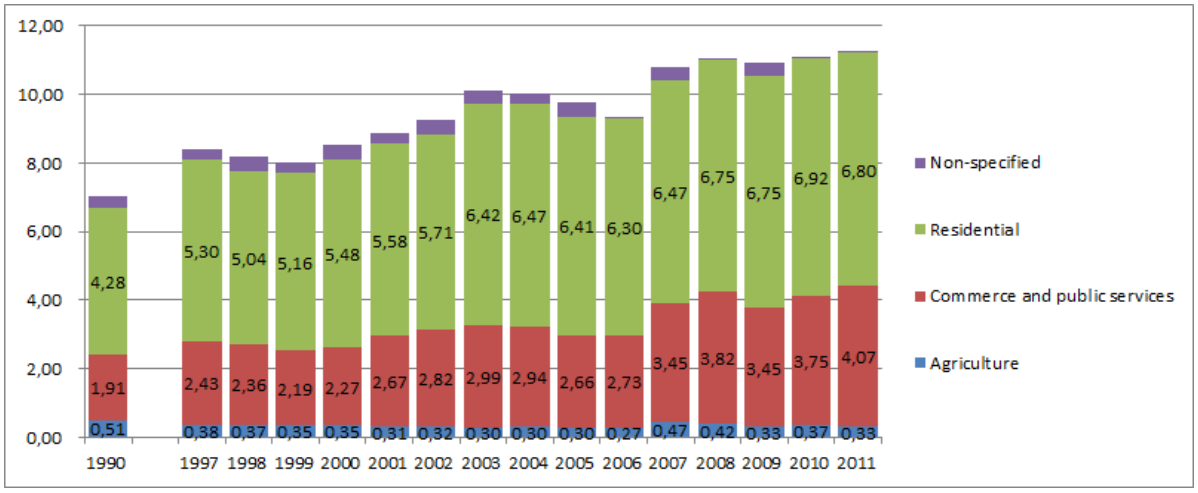


Figure 10: Final energy consumption by sub-sector "other consumption", 1990-2010 (PJ) (Source: EDS, 2013)

According to the census in 2011, there are 194,795 households in Montenegro with an average of 3.2 members per household. Total number of apartments (including cottages etc.) was around 247,000 with an average surface of 71 m^2 per apartment.

After 2004 the activity related to construction works in Montenegro has intensified, especially in the central and southern part of the country. According to available statistical data, 273,000 m^2 in average of new residential buildings were built in Montenegro from 2004 to 2011 on an annual basis.

Buildings before 1990 were built in accordance with the standards of former SFRY and they have relatively low quality. Even though some of these buildings included thermal insulation, it is not functional due to the age of the buildings and due to external influences.

In the last several years, many new apartments were still constructed without thermal insulation or with very poor thermal insulation. However, due to improved awareness by investors, as well as buyers/tenants, the number of new buildings built with better standards in terms of EE is increasing. This is a

result of different activities to increase public awareness, implemented by the ME with the support of donors and the NGO sector, as well as promotional activities of construction companies and suppliers of construction products. From April 2013 on, all newly constructed and reconstructed buildings have to meet the minimal energy efficiency requirements defined by the regulation which will lead to improvement of the overall energy performance of the building sector in the future. These energy efficiency requirements are expected to be even stricter in the upcoming years.

Low prices of electricity for the residential sector in the past lead to the dominant use of electricity for space heating in residential buildings, especially in urban areas. Heat pumps/air conditioners ("split systems") that are usually used for heating have low performance, primarily due to their poor quality, inadequate installations and poor maintenance. Direct electric heating (heat accumulators, electric thermal boilers, electric heaters, etc) are often used for room heating, sometimes even as the only heating source. In addition, electricity is used to heat water in households, especially in urban areas. Thermal solar systems are rarely used. Use of incandescent bulbs is common in Montenegrin households. An increase of electricity consumption is obvious in the summer due to widespread use of air conditioners to cool rooms.

Biomass (wood) is frequently used for room heating in rural areas, especially in the northern part of Montenegro. However, these households mainly burn high quality wood (for industrial processing) in domestic stoves, which have a low efficiency level. Natural gas is not available and district heating is not developed.

4.5.2 EE measures and future trends in residential sector

The largest portion of energy consumption in households is related to space heating, and the greatest reduction in energy consumption in households can be achieved with specific activities improving the thermal insulation and heating systems. In this matter we can distinguish between newly constructed buildings and residential buildings constructed before 2010 with respect to the possibilities of reducing heat loss. Currently there are no available statistics on specific consumption (kWh/m^2) for the household sector. Energy efficiency requirements for the newly constructed and reconstructed buildings are defined by regulations adopted in 2013, which will lead to the improvement of the overall efficiency of this sector in the future. However, future reduction of heat loss of the existing housing stock is the most difficult task, but also holds the greatest potential for action.

Illustration of the potential for energy efficiency improvement in the household sector is given in the EDS reference scenario, in which assumed implementation of very strict regulations on thermal insulation of residential buildings is envisaged. For the newly constructed buildings, it is assumed that after 2012 a regulation on heat losses of only 80 kWh per square meter of heating surface will already have been applied, and that this regulation will be improved to only 15 kWh/m^2 after 2020. For the existing housing stock or old homes, it is assumed that each year 1% of the housing stock will be rehabilitated from 2014 onwards. Of course this requires legislative and organisational preparation that includes financial incentives. It is estimated that the improvement of heat losses per rehabilitated resident unit is 60%. By 2030, 64,500 resident units would be rehabilitated, nearly 30% of the then housing stock, i.e. 4,000 resident units per year. As it is expected that the newly constructed buildings will comprise 25% of the total housing stock, it is presumed that 55% of the then housing stock will have noticeably better thermal insulation.

The overall impact of described improvements of thermal insulation from 2010 to 2030 leads to reduction of heat losses by 35%.

A significantly increased share of solar collectors for preparation of hot water is envisaged. It is presumed that by 2030 approximately 11% of useful heat for the preparation of hot water would be generated from the solar collectors. This is 28% of all units with collectors, i.e. about 39,000 houses or 2,000 houses per year. Such a high share of solar collectors would require incentives, and only a small portion would be achieved without the incentives.

Use of geothermal energy implementing heat pumps was envisaged. It was estimated that by 2030, with incentives, this presently more expensive technology, would be used in some thousands of family hous-

es. In addition to geothermal heat pumps, further use of aero thermal and hydrothermal heat pumps is foreseen.

In the model, the share of individual central heating systems using modern biomass products is modelled by covering 4% of useful thermal heating and hot water needs. Heating systems in the residential sector based on modern biomass fuels are modeled with 50% higher level of activity than conventional fuelwood heating. Also it is envisaged that 5% of space heating and domestic water heating needs in Montenegro will be covered by district heating using biomass products by 2030.

In the EDS reference scenario, a growth of electricity for non-heating purposes in the household sector is envisaged, but in a manner which takes into account technical progress in terms of household appliances. It was estimated that the non-thermal energy consumption per household, without the technical progress, would be higher than 400 kWh in 2030. However, with measures on the demand side and introduction of energy labeling of household appliances, it is possible to reduce this consumption in the future. . Today, noticeably more efficient household appliances are available on the market, and they are gradually replacing the old ones. With promotions and incentives, the process of replacing household appliances could be accelerated. It is estimated that by 2030, non-thermal energy consumption per household will be reduced by 150 kWh with such measures.

Finally, the EDS reference scenario calculated total savings potential in the residential sector as a result of the EE measures to be 0.63 PJ in 2020 and 1.11 PJ in 2030 (*Table 6*).

4.6 Energy efficiency in the agricultural sector

Energy consumption in the agricultural sector is relatively low (max. 0.42 PJ in 2008), its corresponding share in Other Consumption (*Figure 10)* is 3-4%, depending on the observed year. Along with electric and thermal energy, the consumption of motor fuels in agriculture is dominant, mostly diesel fuel for tractors.

In the EDS reference scenario, it is estimated that in relation to 2010, the consumption in this sector will increase faster than the associated growth of GDP by 2030.

It is also estimated that with incentives, 10% of the energy used for heating purposes will be generated directly from biomass, and up to 0.5% from solar energy (thermal collectors).

Total savings potential in the agriculture sector is not estimated.

4.7 Energy efficiency of SMEs

There is no available statistic on the industrial SMEs in Montenegro. Statistical Office of Montenegro – MONSTAT regularly publishes information on enterprise operation but this publication does not contain separate statistics on industrial SMEs and does not contain data on energy consumption per subsectors.

Used methodology classifies business entities according to size into three classes according to the number of employees:

- Small – from 0 to 49 employees
- Medium – from 50 to 249 employees
- Large – more than 250 employees

Total number of active business entities in 2012 amounted to 21,246.

In order to illustrate the size of the business sector in Montenegro, *Table 4* shows some financial indicators: **gross output** (actual produced quantity of goods and services, based on sales, including changes in stocks of goods and services), **intermediate consumption** (value of goods and services that are transformed, used or consumed in the production process), and **gross value added** (difference between gross output and intermediate consumption) by sector of activity of business entities, in thousands of EUR.

As evident from *Table 4* the share of the gross value added of the industrial business is not significant in comparison to the gross value added from businesses in the service sector and construction.

Table 4: Gross output, intermediate consumption, and gross value added by sector of activity, in thousand EUR (Source: Enterprise operation year 2013, 2014)

Section	Title	Gross output	Intermediate consumption	Gross value added
B	Mining and quarrying	61 604	27 737	33 868
C	Manufacturing	417 261	304 017	113 244
D	Electricity, gas, steam and air conditioning supply	251 177	104 927	146 250
E	Water supply; sewerage, waste management and remediation activities	101 333	36 830	64 503
F	Construction	366 170	296 510	69 660
G	Wholesale and retail trade; repair of motor vehicles and motorcycles	762 278	388 066	374 212
H	Transportation and storage	319 846	200 722	119 123
I	Accommodation and food service activities	212 491	117 351	95 140
J	Information and communication	283 035	129 854	153 181
L	Real estate activities	44 709	38 769	5 940
M	Professional, scientific and technical activities	206 218	145 442	60 775
N	Administrative and support service activities	124 442	89 639	34 804
P	Education	15 161	5 179	9 982
Q	Human health and social work activities	34 444	12 680	21 763
R	Arts, entertainment and recreation	58 686	34 165	24 521
S	Other service activities	22 364	10 152	12 212

Note: *The following sectors of activity according to the classification KD 2010 are not included in this study: agriculture, forestry and fishing; financial and insurance activities; public administration and defense, compulsory social security; activities of households as employers, household activities that produce goods and services for their own use; activities of extraterritorial organizations and bodies*

As there is no study on energy efficiency of SMEs, the following can be concluded:

- The main share of SMEs belongs to the trade sector. Thus the main energy saving potentials for SMEs can be expected in energy savings related to buildings and transportation.
- Only a small share of SMEs belongs to industrial SMEs, the mayor part belongs to the services. However, in some sub-sectors e.g. manufacturing of food products, beverages and tobacco some energy efficiency potential can be expected (refer to chapter 4.4)."

4.8 Summary on energy efficiency potential

The energy sector in Montenegro is characterised by high-energy intensity compared to the EU and more developed countries, which is a consequence of the high level of energy consumption of the aluminum and steel industry. Energy intensity in the final consumption of energy was at a maximum level in 2000 and amounted to 26,387.7 *MJ/000 EUR-2000,* which was from 4 to 6 times higher than the value in EU-15 and higher than almost all other countries in the region (Figure 1). All of this indicates that there is considerable opportunity for energy savings. High values of energy intensity are concerning, especially in light of the relatively small final energy consumption level per inhabitant in Montenegro, that is 5 times below the average of more developed countries (Figure 12).

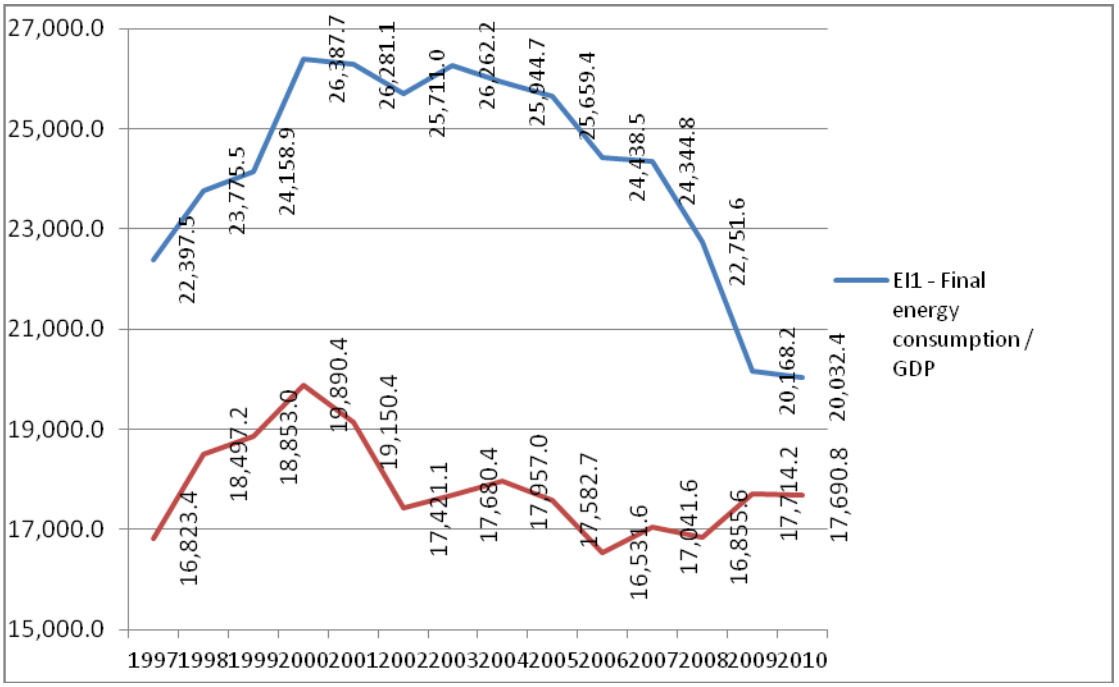


Figure 11: Energy intensity with (blue line) and without energy consumption of KAP (red line), 1997-2010 (MJ/000 EUR-2000)
(Source: EEAP for the period 2013-2015, 2013)

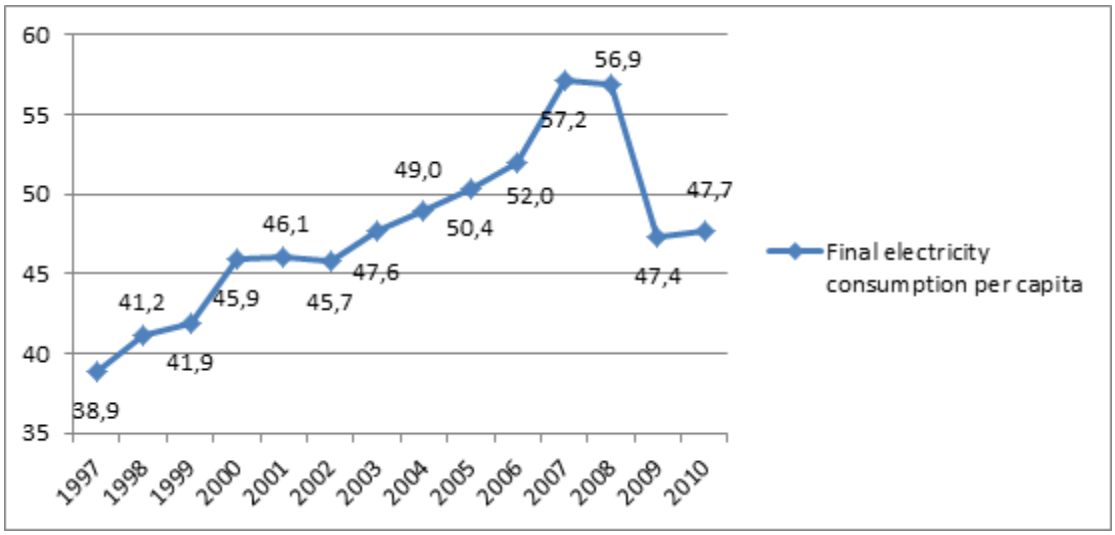


Figure 12: Final energy consumption per capita in Montenegro, 1997-2010 (GJ/capita) (EEAP for the period 2013-2015, 2013)

According to the Energy Development strategy of Montenegro by 2030, the transportation, households, and services sectors in the EDS reference scenario will achieve significant energy savings due to market improvements in energy efficiency (transfer of technologies). Total final energy savings of the EDS Reference scenario *("High scenario with measures"*) vs. *"High scenario without measures"* are shown in *Table 6,* and does not include saving in KAP and Steelworks in Niksic.

Table 5: Total final energy savings by sector – High scenario with measures vs. High scenario without measures (PJ)
(Source: EDS, 2013)

Sector	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2025	2030
Industry	0.00	0.01	0.01	0.03	0.05	0.07	0.09	0.10	0.12	0.14	0.16	0.18	0.26	0.41
Transport	0.00	0.01	0.03	0.08	0.13	0.22	0.35	0.50	0.65	0.83	0.99	1.12	1.66	2.18
Households	0.00	0.02	0.06	0.11	0.17	0.21	0.27	0.36	0.44	0.53	0.63	0.70	0.87	1.11
Services	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.06	0.11	0.16	0.23	0.22	0.42	0.83
TOTAL	***0.00***	***0.04***	***0.10***	***0.22***	***0.35***	***0.51***	***0.75***	***1.02***	***1.32***	***1.66***	***2.01***	***2.23***	***3.21***	***4.52***

A rough estimation of the investment required to achieve the above mentioned savings of 2.01 PJ in 2020 and 4.52 PJ in 2030 is given in the Table 6.

Table 6: Estimation on required investments for energy efficiency (mill. EUR)
(Source: EDS, 2013)

	2012-2021 Mill. EUR	2022-2030 Mill. EUR	Total Mill. EUR
Private capital	266.55	335.86	602.41
Public funds and contribution of donors	82.17	103.53	185.70
Total investment	348.72	439.39	788.11

The above calculation is performed as an indication of the required private and public investments in order to achieve the anticipated energy savings, assuming also that part of the investments in the public sector will come from private sector sources (e.g. third party financing). Exact investment costs can be analytically calculated only when the specific measures are designed in detail.

Table 8 contains an example of a rough calculation of the required investment for energy efficiency by sectors for 2020 for the current energy prices.

Table 7: Calculation of the required investment for energy efficiency by sector for 2020 (mill. EUR)
(Source: EDS, 2013)

	Industry	Transport	Households	Services	TOTAL
Energy savings in 2020 (PJ)	0.16	0.99	0.63	0.23	2.01
Average energy cost (EUR/kWh)	0.05	0.11	0.09	0.08	
Payback period for the private investor (years)	5.0	5.0	5.0	5.0	
Private investment (EUR/kWh saved)	0.263	0.550	0.455	0.376	
Total private investment (mill. EUR)	11.70	151.25	79.56	24.04	266.55
Additional average payback period to be covered by incentives - public funds (years)	3.0	3.0	3.0	3.0	
Applicable to the percentage of investment (%)	30.0	30.0	85.0	85.0	
Public incentives required (EUR/kWh saved)	0.047	0.099	0.232	0.192	
Total public incentives (mill. EUR)	2.11	27.23	40.57	12.26	82.17
TOTAL INVESTMENT REQUIRED (1+2)	13.81	178.48	120.13	36.30	348.72

5 Framework for Energy Efficiency

This section of the report analyses the framework conditions for carrying out energy efficiency projects. The main questions to be asked are:

- Is energy efficiency, its actors, targets, or specific measures mandated or supported in any legal or policy related document(s)?
- Are technical capacities in place in 2015 to realise specific measures?
- Are investments in energy efficiency economically justified?

5.1 Legal and policy framework

5.1.1 Legal and regulatory framework

The following table provides an overview of the current energy and EE policies in Montenegro:

Table 8: Energy and EE laws and policies

Year	Name of the law
2003	Law on Energy
2010	Law on Energy
	Law on Energy Efficiency
2013	Amendments to the Law on Energy
2014	**Law on Efficient Use of Energy (repeals Law on Energy Efficiency)**
2015	**Law on Energy (still in procedure; expected to be adopted in 2015)**
Year	**Name of the by-law**
2011	Instruction on determining methodology for calculation of the indicative energy saving target
2011	**Decision on determining the indicative energy saving target**
2011	Rulebook on the content of the report on implementation of the Energy Efficiency Improvement Plan by local self-government unit
2012	Rulebook on the information system of energy consumption and on the manner of submission of data on annual consumption of energy
2012	Instructions on energy efficiency measures and guidelines for their implementation
2012	**Rulebook on determining limit for energy consumption to define big consumer, the content of the energy efficiency improvement plan and report on the plan implementation**
2013	**Rulebook on the minimal energy efficiency requirements in buildings**
2013	Rulebook on energy performance certification of buildings
2013	Rulebook on methodology for energy audit performing
2013	Rulebook on training programme for energy audits, content of the requests for issuing the authorisation and registry of authorised persons
2013	Rulebook on regular energy audits of air conditioning systems and heating systems

** Entries in bold are of significant importance in terms of EE.*

Note: All adopted by-laws can be downloaded on the link http://energetska-efikasnost.me/dokumenti.php?l=mn.

Law on Efficient Use of Energy (O.G. of Montenegro, No. 57/2014 on 26 December 2014) shall regulate relations within the area of efficient energy use in final consumption sectors, obligation of adopting programmes and plans for improving energy efficiency at national and local levels, as well as at the level of energy entities and consumers, their implementation, public authorisations and responsibilities for introduction and implementation of energy efficiency policy, so as all additional energy efficiency measures and entities responsible for their implantation. The present Law shall not refer to energy efficiency of the facilities for production, transmission and distribution of energy. Energy efficiency in these facilities is regulated by the Energy Law.

The text of the Law on Efficient Use of Energy is compliant with main EU directives in the field of energy efficiency, as follows:

- Directive 2012/27/EC on energy efficiency;
- Directive 2010/31/EC on the energy performance of buildings;
- Directive 2010/30/EU on energy labeling of energy related products;
- Directive 2009/125/EC establishing a framework for the setting of eco-design requirements for energy-related products.

Preparation and adoption of relevant bylaws is in progress with aim of completion of framework for the successful implementation of the Law.

Law on Energy (O.G. of Montenegro, No. 29/2010) specifies energy activities and regulates terms and conditions for carrying out of those activities in order to ensure quality and secure energy supply to final customers; public services and other activities in the energy sector of public interest for Montenegro; procedure for organisation and functioning of the electricity and gas market; manner and conditions for use of renewable energy sources and cogeneration; energy efficiency in the sector of energy generation, transmission, and distribution, as well as other matters of relevance for the energy sector.

The existing Law on Energy is written in accordance to EU *acquis* in the field of energy. Currently under preparation is the new Law of Energy (expected to be adopted in 2015) which will consider the new requirements of the EU *acquis* regarding: 'third internal market package', renewable energy sources as well as energy efficiency on the supply side.

Rulebook on determining limit for energy consumption to define big consumer, the content of the energy efficiency improvement plan, and report on the plan implementation

The Law on Efficient Use of Energy (and also an old Law on Energy Efficiency) provides for obligations for large consumers of energy regarding: establishment of energy management, preparation of the annual energy efficiency plans, and regular reporting to the Ministry of Economy on achievement. All these obligations are closely regulated by the *Rulebook on determining limit for energy consumption to define big consumer, the content of the energy efficiency improvement plan, and report on the plan implementation*. The Rulebook defines the Big Consumer as an entity with a total annual consumption of primary energy equal or higher than 10,000 MWh.

However, the fact that no entity acquired the status of Big Consumer is the best indicator of the application of the Law in this area.

5.1.2 Main strategic and planning documents

Energy Development Strategy of Montenegro by 2030 was adopted on 10.07.2014. Updating the Energy Development Strategy by 2025 and its upgrading by 2030 is based on the document "Energy Policy of Montenegro by 2030", adopted by the Government in March 2011. Planning energy development and periodic update of the State's strategic planning documents of the highest rank in the field of energy is an obligation arising from the Law on Energy.

The updated Strategy, among others, deals with the field of energy efficiency in a separate chapter, and provides specific recommendations and guidelines for the medium and long term planning.

According to the Law on Efficient Use of Energy (2014) the main planning document in the field of energy efficiency at the state level is the Energy Efficiency Action Plan. This obligation arises from the membership in the Energy Community where the Contracting Parties (signatories of the Energy Community Treaty) undertook the obligation, among others, to implement the Directive 2006/32/EC on energy end-use efficiency and energy services. According to requirements of this Directive, Contracting Parties shall prepare three national Energy Efficiency Action Plans (EEAP) in the period 2010 – 2018 as follows:

- First EEAP not later than 30 June 2010;
- Second EEAP not later than 30 June 2013;
- Third EEAP not later than 30 June 2016.

The first Energy Efficiency Action Plan for the period 2010-2012 was adopted by the Government of Montenegro in December 2010. The second Energy Efficiency Action Plan for the period 2013-2015 was adopted by the Government of Montenegro in November 2013.

The second EEAP is mainly a continuation of implementation of activities from the first Energy Efficiency Action Plan for 2010-2012. However, the second EEAP significantly amends the first EEAP based on new and stringent requirements of the EU presented through adoption of updated directives in the field of energy efficiency.

According to the Energy Community Treaty, Montenegro is obliged to achieve the indicative energy savings target which represents savings in the amount of 9% of average final consumption of energy in the country in a five-year period in the ninth year of implementation of the Directive. According to the Directive, the established period of time for meeting the indicative energy savings target is from 2010 until 2018.

This plan covers the period from 2013 to 2015 and it provides for an intermediate indicative energy savings target for this period of time in the amount of approximately 3% of the average annual final energy consumption in the five-year period 2002-2006.

The second EEAP has double significance and it represents the following:

- a comprehensive document for the implementation of the energy efficiency policy on the side of final consumption of energy for the next three-year period;
- a report with detailed review of activities implemented in the previous period and an evaluation related to achieved energy savings compared to the objectives set in the first EEAP.

Main objectives of the second EEAP are based on the priorities of the Law on Energy Efficiency, as follows:

- Implementation of the Law on Energy Efficiency by completing and improving the regulatory framework and a significant improvement of the institutional framework;
- Raising public awareness and improving understanding, knowledge, and capacities in terms of new legal requirements and good practise in the field of energy efficiency in institutions of the public sector, local self-governments, big consumers, professional organisations and other stakeholders;
- Significant improvement of statistical and monitoring system in the field of energy efficiency;
- Implementation of energy saving measures with noticeable results.

The Second EEAP recognized 27 energy efficiency measures in the following sectors: buildings (3), residential (3), services (7), industry (1), transport (5), energy entities (1), horizontal measures (7). The EEAP also gives a review of required financial resources, estimation of energy savings, as well as information on entities responsible for implementation of the concrete measures.

The EEAP measures are mainly designed to support implementation of the obligations from the Law:

- Further development of the energy performance requirements in buildings and establishment of the buildings energy certification,
- Establishment of energy management in the service sector (public and commercial) as well as in the industry sector,
- Establishment of the supporting mechanisms for the citizens,
- Improvement of the EE in the public buildings,
- Awareness raising on EE among different groups of energy users in all sectors.

5.1.3 EE projects and supporting schemes

Implementation of projects and activities related to energy efficiency are mainly coordinated by the Directorate for Energy Efficiency of the Ministry of Economy as central institution for energy efficiency in Montenegro. Besides the project related to the reconstruction of public buildings there are a few supporting schemes for energy users in other sectors that are shown in *Table 10*.

Table 9: Public support systems (incentives)
(Source: EEAP for the period 2013-2015, 2013)

Title / Organisation	Available Support	Description
Interest-free loans project for solar panels for water heating in households (MONTESOL)	1 mill. USD	**Responsible body**: Ministry of Economy in cooperation with its partners within the framework for environmental protection at the United Nations (UNEP), and the Italian Ministry of Environment, Land and Sea (IMELS) **Funds:** 1 mill. USD provided by the Italian Ministry of Environment, Land and Sea (IMELS) **Mechanism:** Interest-free loans to households for the installment of solar panels for water heating distributed via commercial banks. Possible individual loans in the amount up to € 5,000, with a repayment period of up to seven years, with an interest rate of 0%. **Future plans:** It is planned to extend the project to individual legal entities in the tourism sector, for that sector the loan amount would be increased (up to € 50,000), with a repayment period of up to seven years and a 0% interest rate.
Interest-free loans project for the installation of the systems on modern forms of biomass for households (ENERGY WOOD)	130,000 Eur (phase I) 240,000 Eur (phase II)	**Responsible body:** - Ministry of Economy, in cooperation with the Luxembourg Agency for Development and Cooperation (Lux-Development) – phase I - Ministry of Economy – phase II **Funds:** - 130,000 Eur provided by the Dutch Government – phase I - 240,000 Eur provided by the Norwegian Government – phase II **Mechanism:** Interest-free loans to households for the installation of heating systems (boilers and furnaces) on modern forms of biomass (pellets, briquettes) distributed via commercial banks. Possible individual loans in the amount up to € 5,000, with a repayment period of up to seven years, with an interest rate of 0%. **Future plans:** Phase I is almost completed. Phase II is under preparation.
Installation of solar photovoltaic systems for production of electricity in summer pasture households (SOLARNI KATUNI)	125,000 Eur (in 2011 and 2012)	**Responsible body:** The Ministry of Economy and the Ministry of Agriculture and Rural Development Funds: 125,000 Eur were provided from state budget in 2011 and 2012 **Mechanism:** State covers 80% of the cost of the photovoltaic system, and end user cover remaining 20%. In two phases 189 systems were installed in households situated in summer pasture lands which are not connected to the electric grid **Future plans:** The project is planned to be continued. New tender will be published again in 2015.
Subsidies for installation of solar systems in new buildings	2010-2014	**Responsible body:** Montenegrin municipalities (Podgorica and Budva) **Mechanism:** Subsidies for installation of solar systems in new buildings, by reducing utility fee (fee for utility land) in the amount of 100-150 € per square meter of installed solar panel. **Note:** The programme has to be relaunched every year by approval of the responsible institutions in municipalities.

5.2 Technical framework

Montenegro, as a relatively small country, does not have its own production of almost any energy efficient technology. However, the Montenegrin market of energy efficiency related equipment and material is well

developed and based on imports from all around the world (EU, Asia Countries, US, etc.). This leads to a wide variety of equipment and materials (with a very high variation of models and efficiencies as well as prices) available to consumers, who often need "expert" support in selecting the proper equipment due to availability of different types.

The Montenegrin market of energy efficient equipment has a good assortment of: HVAC equipment (boilers and air-conditioning units), solar water heaters, efficient windows and insulation materials, PV systems, efficient motors and pumps and LED technologies. However the availability of some technologies is rather limited such as: small scale absorption chillers, small scale CHP units, small scale biogas systems, and wind and hydro turbines.

Although there is no production of such equipment and materials (except assembling of efficient windows in a few smaller factories), authorised dealers usually employ licensed installers and provide equipment maintenance in the warranty and after warranty period.

5.3 Economic framework

There are no publicly available studies on the economic viability of energy efficiency investments. However, investment in EE in public buildings realised in the last few years give some indication regarding the payback period of some common measures:

- Replacement of windows – 6-8 years,
- Insulation of walls – 4-6 years,
- Replacement of boilers – 5-7 years,
- Installation of efficient lighting – 2-4 years.

The economic viability of energy efficiency measures depends on several factors such as the unit energy costs (energy form and energy tariff), investment costs (chosen technology), O&M costs before and after the investment, operating hours of the building/system, etc.

Keeping in mind the fact that energy prices in the residential sector are even higher, the payback period for some of the specified measures would be shorter.

Energy indicative current prices of common energy forms in the industrial and residential sectors are shown in the table below. Electricity prices are calculated on the basis of today's prices for different categories of consumers (VAT is applied in electricity prices for households as VAT is not recoverable by them). Electricity price for the households is significantly higher than in the industrial sector because the households are consumers that are connected to a 0.4 kV distribution network, and industry consumers can be connected to 10 or 35 kV distribution network with lower electricity tariffs. The industry sector does not include KAP, which is not connected to the transmission network and has its own supplier of electricity.

Table 10: Energy indicative current prices of common energy forms in Montenegro in 2013
(data collected by consultant)

Sector	Average energy prices EUR/kWh			
	Electrical energy	LFO	Coal	Wood
Industry	0.06	0.10	0.024	-
Residential	0.10	0.10	0.024	0.016

As it is evident from *Table 11,* energy prices are significantly lower than the EU-28 average. Electricity price for households of 0.10 EUR/kWh is 50% lower compared with EU-28 values of 0.2 EUR/kWh. Also the electricity price for the industrial sector in Montenegro (0.06 EUR/kWh) is two times lower than average price in EU-28 (0.12 EUR/kWh).

There are no publicly available studies on the economic viability of energy efficiency investments and the figures given below represent estimation of the local consultant, based on the experience from the im-

plemented projects. The economic viability of energy efficiency measures depends on several factors such as the unit energy costs (energy form and energy tariff), investment costs (chosen technology), O&M costs before and after the investment, operating hours of the building/system, etc.

Table 11: Simple payback period
(based on expert estimation)

Type of project	Simple pay-back period (years)	Remarks
Industrial Sector		
Introduction of the energy management	1 - 2	Short payback due to the almost zero investment. The measure can be considered as pure organizational or some central energy monitoring system can be established as a supportive tool.
Thermal insulation for high temperature equipment (heat generators, pipelines etc.)	2 - 3	Short payback period due to the very low investment costs and high operating hours
Introduction of the heat recuperation in industrial facilities	3 - 5	Large potential – heat recuperation was not widely used in Montenegro in earlier period (15-25 years before) due to the low energy prices
Increase coefficient of performance of existing boilers	3 - 6	Large potential due to the outdated technology with low coefficient of the performance
Introduction of the Co-generation of Heat and Power (CHP) and tri-generation systems	8-10	Long payback period due to the high prices if the diesel/LPG and unavailability of the natural gas in Montenegro.
Improvement of the electric drives (more efficient electric motors, VSD)	4-7	Payback period depends on the operating hours.
Residential Sector		
Thermal insulation of walls and roofs	4 - 6	Low payback period due to low investment costs especially for the individual houses with central heating
Replacement of windows	5 - 9	Investment and the payback period depends on the operating hours and climatic zone
Installation of the solar hot water systems	5 - 8	Low payback period especially for the buildings with higher operating hours
Introduction of the boilers/stoves on the modern biomass fuels	3 - 7	Payback period depends on the existing fuel, operating hours and climatic zone
Public and Private Service Sectors		
Thermal insulation of walls and roofs	4 - 6	Low payback period due to low investment costs especially for the buildings with high operating hours
Replacement of windows	6 - 10	Investment and the payback period depends on the operating hours and climatic zone

Installation of the solar hot water systems	3 - 6	Low payback period especially for the buildings operating in the summer period (hotels, hospitals)
Replacement of boilers (introduction of the modern biomass fuels)	5 - 7	Low payback period due to low investment costs and high electricity, LPG and LFO prices
Installation of efficient lighting in buildings	2 - 4	Very low payback period due to the low investment costs and high electricity costs

5.4 Awareness and information level

Previously, great attention was dedicated to the process of raising public awareness about the importance and effects of implementation of energy efficiency measures. A strong, ongoing, and overall public campaign was conducted. The campaign was initiated by the Ministry of Economy, under the project "Energy Efficiency Year" (2008). In this regard, several public events took place and different promotional material was prepared intended for the wider public, as well as certain target groups (ministries, local self-governments, donors, professional associations, etc.). In addition, through public media (daily newspapers, TV, radio, internet, etc.) a large volume of promotional material was distributed in various forms (brochures, TV promotional films and video, advertisements, articles, promotional exhibitions, etc.).

This campaign was accompanied by a regular annual public poll (2008-2013) and special reports were prepared in this regard. Public polls showed that more people were familiar with the energy efficiency concept in 2013 compared to 2008. The awareness was improved by 24.8 % (from 23.6 % to 48.4 %).

It is important to emphasise the following activities that were carried out under the campaign:

- Three large international conferences on the following topics: “Energy Efficiency and Energy Security”, “Sustainable Energy Management in Public Buildings - from Policy to Local Action”, and “Energy Efficient Lighting” were organized in 2009, 2010, and 2011 with the support of GIZ.
- Educational TV series "Smart energy" was broadcasted (12 episodes);
- In the period 2010-2012, information centres for energy efficiency were opened in the Capital Podgorica and Bijelo Polje, as well as 7 infomation offices under the existing Regional business centres in Niksic, Berane, Cetinje, Bijelo Polje, Zabljak, Plav, and in Rozaje. An information telephone line (080 081 660) is available under the information centre in Podgorica;
- The Government of Montenegro, in cooperation with EPCG and media partners, has launched the initiative ”Join in!“ in 2011 with the aim of raising the public awareness of all consumers in relation to rational and efficient usage of energy;
- During 2011 and 2012 promotional activities were organised in 21 Montenegrin municipalities, around 7000 saving bulbs were distributed to citizens, as well as brochures with advice for households regarding energy efficiency;
- Web site www.energetska-efikasnost.me, was opened in 2009 and it was redesigned in 2011;
- The project ”Energy tour“ was implemented during 2011 and 2012 with the aim of introducing pupils in the final years of elementary school to energy efficiency and expanding their knowledge in the area of climate change and renewable energy sources;
- Promotion of energy efficiency at Construction fairs held in Budva in 2010, 2011, and 2012, which were mostly dedicated to this topic.

In addition, under the organization of other actors (NGOs, Mechanical Faculty, National Academy, specialised companies, etc.), there was a number of conferences held which targeted the principles of energy efficiency, the latest technology and knowledge in this field. Other public events were held as well (workshops, presentations, etc.) which partially implemented the concept of knowledge transfer, but which by its nature have a character of public awareness raising on energy efficiency.

6 Conclusions

Based on presented studies and local experts' experience, there is large untapped potential for implementation of energy efficiency measures in Montenegro. The energy sector in Montenegro is characterised by high-energy intensity compared to the EU and more developed countries, which is a consequence of high levels of consumption in the aluminum and steel industry. High values of energy intensity are concerning, especially if we take into account the relatively low level of final energy consumption per inhabitant in Montenegro that is 5 times below the average of more developed countries. All of this indicates that there is considerable room for energy modernisation.

It is expected that final energy consumption will be doubled by 2030 in relation to 2010. In the structure of future final energy consumption, a noticeable increase in the share of transportation and industry, and stagnation of the share of households and services is predicted.

In 2010/2011, energy consumption in the processing industry, apart from KAP and Steelworks, was very small (electricity consumption below 50 GWh) but expected to significantly increase by 2030 due to the development of the industrial sector (refer to chapter 4.2). New facilities will use new technologies, given that it is almost certain that private investors will make investments. This will lead to decreasing of the energy intensity in this part of the industrial sector which will be result of structural changes, introduction of more efficient technologies in industrial processes, and above all, more competitive products with higher added value which reach higher prices on the market. On the other hand, due to the uncertain future of KAP and Steelworks, it is questionable that energy efficiency measures will be introduced in these companies.

The largest portion of energy consumption in households is related to space heating, and the greatest reduction in energy consumption in households can be achieved with specific activities which relate to the improvement of thermal insulation and heating systems. In this matter we can distinguish possibilities of reducing heat losses of newly constructed buildings and residential buildings constructed by 2010. Heat losses of newly constructed buildings can be defined by laws and regulations, and the control of compliance with the laws and regulations is easier to implement for apartment buildings than for single family houses. Reduction of heat loss of the existing housing stock is considered the most challenging task; however, this also holds the greatest potential for action.

Energy consumption in the agricultural sector is relatively low (max. 0.42 PJ in 2008), so the total saving potential in this sector is not estimated.

The main share of SMEs belongs to the trade sector. Thus the main energy saving potentials for SMEs can be expected in energy savings related to buildings and transportation. In some sub-sectors e.g. manufacturing of food products, beverages and tobacco some energy efficiency potential can be expected.

The legal framework for developing EE and larger use of RES is well developed and follows requirements of EU *acquis* and EN standards. State policy is well defined through strategic and planning documents which are regularly updated.

In order to achieve considerable energy savings, significant financial resources should be mobilised, which means that all stakeholders (state, ministries, municipalities, and other interested parties) have to allocate necessary human and financial resources. The energy market should be further liberalised, especially in terms of provisioning energy services. In this regard, it is necessary to further develop public and private partnerships in the field of energy efficiency especially through ESCO, which is not developed at all.

Availability of public support schemes should be further strengthened and should cover other sectors (industry, services, SMEs, etc.) and include different types of mechanisms. Implementation of energy efficiency measures should go hand in hand with awareness raising programmes for different target groups in order to reduce the energy consumption and to produce useful energy in a more efficient way.

The market for energy efficient equipment and materials should be further developed. Local production of such equipment/materials should be supported and mechanisms for quality control of the available products on the market should be improved.

7 Relevant Institutions

The following table provides an overview of institutions relevant for EE in Montenegro.

Table 12: Institutions relevant for EE in MONTENEGRO

State bodies	
Ministry of Economy (www.mek.gov.me)	Ministry of Economy (ME) is the ministry responsible for energy, in particular for Energy Policy and Strategy of the state, as well as for the preparation of laws and key bylaws in that sector. Within the ME three directorates cover energy issues: Directorate for Energy, Directorate for Energy Efficiency, and Directorate for Mining and Geological Explorations.
Ministry of Economy/Directorate for the Energy Efficiency (www.energetska-efikasnost.me)	Directorate for Energy Efficiency is tasked with creating and implementing energy efficiency policy. The Directorate for Energy Efficiency was established in November 2009. On the basis of the Act on Systematisation and Organisation 8 job positions were planned. Currently, the Directorate employs 5 staff members including a Deputy Minister, and three temporary consultants. The main objectives and mission of the Directorate for Energy Efficiency arise from the competences of the Ministry of Economy related to the EE and according to the best EU practice. The main objectives include: - Identification, analysis, and proposition of technically possible and cost effective policies and measures for EE improvement related to the energy consumption side. - Encouraging and promoting activities directed to savings and other EE activities, as well as reducing negative environmental impacts caused by energy conversions in energy consumption processes. - Promotion of RE use and use of other non-traditional sources with low environmental impact. - Promotion and participation in sharing knowledge and information with similar authorities of other countries and with international institutions and associations active in the EE field.
Ministry for Sustainable Development and Tourism (www.mrt.gov.me)	Ministry for Sustainable Development and Tourism is, inter alia, responsible for spatial planning and construction of structures. Therefore this Ministry together with Ministry of Economy/Directorate for the Energy Efficiency is responsible for energy efficiency in buildings. This responsibility is defined by the Law on Efficient Use of Energy (2014).
Other related institutions	
Statistical Office of Montenegro – MONSTAT (www.monstat.org	Statistical Office of Montenegro - MONSTAT is the competent body for the production of official statistics. National and international public recognise MONSTAT's role as a provider of official statistics in Montenegro's statistical system. As the statistical leader, MONSTAT is obliged to collect data, processes and disseminate statistics performed in an independent, professional, transparent, and highly expert manner.
Chamber of Economy of Montenegro (www.privrednakomora.me)	Chamber of Economy of Montenegro is an independent, business, competent and an association of interest that gathers business organisations, financial institutions, insurance companies, entrepreneurs, and other groups performing economic activities in Montenegro.
Engineers Chamber of Montenegro (www.ingkomora.me)	The Engineers Chamber of Montenegro is a legal entity with rights and obligations determined by Law and the Chamber's Statute. In order to provide expertise and to protect the public interest, persons working in spatial planning and construction prescribed by the Law, enroll in the Chamber in the field of spatial planning and construction of structures.
Montenegrin Energy Efficiency Centre (www.ccee.me)	Montenegrin Energy Efficiency Centre is a professional association of energy auditors i.e. architects, civil, mechanical, and electrical engineers who have completed training and received a license for performing energy audits of buildings.
Energy Regulatory Agency (www.regagen.co.me)	Energy Regulatory Agency was established in 2004 as autonomous, functionally independent, non-profit organisation that carries out its public authorisations in the energy sector in accordance with the Energy Law, for the purpose of regulating the energy sector in Montenegro.
Montenegro Chamber of Skilled Crafts and Entrepreneurship (www.zanapredak.me	Montenegro Chamber of Skilled Crafts and Entrepreneurship (ZanaPredaK) is the umbrella organisation representing professional, economic, and social interests of Montenegrin small and medium sized enterprises, organised by 15 professional associations.
Union of Architects of Montenegro (www.sacg.me)	Union of Architects of Montenegro is a professional association of architects Montenegro.

By 2008, local capacity dealing with EE/RES was rather limited and interesting only for a small number of experts involved in this issue.

However with the adoption of the Energy Development Strategy in 2007, topics of EE/RES became more interesting and the Ministry of Economy started to create a framework, and in cooperation with other institutions/organisations, to work on promotion of the EE/RES.

With the adoption of the Energy Efficiency Law in 2010 and the adoption of the rulebooks which regulate energy performance requirements in buildings in 2013, professionals in the market (engineers, craftsman, etc) became more and more interested in the topics of energy audits, energy performance calculation, implementation of efficient solutions, etc.

In parallel, there were a few initiatives from other organisations and companies in the field of training craftsmen and entrepreneurs to apply concrete, technical solutions e.g. solar technologies, thermo facades, etc.

Besides that, it is evident that new technologies coming onto the market required skilled professionals for their installation and maintenance, so the equipment dealers were interested in having qualified staff to deal with the products that they sell.

The ESCO concept is not developed at all. The legal basis for energy services is established through the Law on Efficient Use of Energy but there no concrete ESCO projects have been implemented. The Ministry of Economy is currently working on further development of the legal framework for ESCO with the support of the European Bank for Reconstruction and Development (EBRD).

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