MSc Program

Renewable Energy in Central and Eastern Europe

RES Market in Montenegro

A Comparative Analysis of the Montenegrin RES Market and the Country´s Potential of RES

A Master's Thesis submitted for the Degree of
"Master of Science"

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Vienna, November 2011

Affidavit

I, Elisabeth Mayer, hereby declare

1. that I am the sole author of the present Master Thesis, **"RES Market in Montenegro; A comparative Analysis of the Montenegrin RES Market and the Country´s Potential of RES"**, 134 pages, bound, and that I have not used any source or tool other than those referenced or any other illicit aid or tool, and
2. that I have not prior to this date submitted this Master Thesis as an examination paper in any form in Austria or abroad.

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Abstract

The purpose of this Master Thesis is to analyze the Montenegrin renewable energy market with its actual and future potential and the country´s 2020 energy and climate target assessment. Furthermore this market will be evaluated in accordance with national policies and investment opportunities as well as the European perspective. Also the country´s competitiveness of proposed support systems for RES will be elaborated under the framework of the Energy Community and EU agenda.

Three types of RES are analyzed with regard to their potential, long run generation costs, their current situation of implementation (status quo analysis) and their proposed support schemes. These types are hydropower, wind energy and biomass. Solar thermal energy, municipal solid waste and biofuels are also discussed with regard to their potential, availability and prospect.

The above gained information will be compared with the Hungarian RES market according to the study of "Renewable Energy Industry Roadmap for Hungary" and results will be elaborated in accordance with implemented policies and proposals for future provisions The conclusion of this study determines, that the country has a promising potential for renewable energy, but does not apply it effectively nor sustainably. However, the country is still far away from having implemented accurate renewable energy policies and frameworks and lacks of a profound strategy to attract foreign and local investment. This fact also gives some profound arguments that privatization of State assets goes sometimes hand in hand with corruption. A typical example is tender procedures which were several times cancelled or were won by the second or third best offer. In the moment the country follows a strategy of selling off its energy producing infrastructure to international investors and does not seriously focus on implementing support schemes for decentralized RES for solar or biomass by example. These energy sources could definitely boost the production of green energy.

The availability of reliable statistics is another problem as well as a certain lack of political commitment towards the privatized aluminum smelter KAP. This smelter inhabits a predominant share in final energy consumption of 40% and demands a final solution and decision by the Montenegrin Government. In officially presented statistics for the EU 2020 energy goal proposals, the government prefers to offer 2

scenarios, namely one with KAP and one without KAP, which cannot be an acceptable solution in the long run.

Also the inability to correctly evaluate the inbound tourism in strategy papers for future energy consumption and supply is a main deficit in all official documents and statistics. The current peak season of 3 months receives approximately an additional one third of the Montenegrin population in terms of tourists and it is planned that this number will be almost 5 times more compared to 2010 figures. None of the governmental statistics is dealing with this very important fact, because these peak times need to be considered and evaluated in the country´s future energy strategy.

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Abbreviations

BAU	Business-As-Usual
C	Generation Costs per kWh
CO&M	Operation and Maintenance Costs per Energy Unit
CRF	Capital Recovery Factor
EAR	European Agency for Reconstruction
EBRD	European Bank for Reconstruction and Development
EC	European Commission
EE	Energy Efficiency
EE	Eastern Europe
EIB	European Investment Bank
EnC	Energy Community
EPCG	Elektroprivreda Crna Gora
ERRA	Energy Regulators Regional Association
EU	European Union
FIT	Feed in Tariff
GDP	Gross Domestic Product
GFEC	Gross Final Energy Consumption
GTZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
H	Full Load Hours per Year
I	Investment Costs per kW €/kW_{el}
IEA	International Energy Agency
IFI	International Financial Institutions
IMELS	Italian Ministry of Land and Sea
IMF	International Monetary Fund
IPA	Instrument for Pre-Accession
KAP	Kombinat Aluminijuma Podgorica
KfW	Kreditanstalt für Wiederaufbau
LRGC	Long Run Generation Costs
MOL	Magyar Olaj- és Gázipari Részvénytársaság
MSW	Municipal Solid Waste
NEEAP	National Energy Efficiency Action Plan
OECD	Organization for Economic Cooperation Development
PV	Photovoltaic
RAE	Regulatory Energy Agency

RES	Renewable Energy Sources
REPAP	Renewable Energy Policy Action Paving
SFRY	Social Federal Republic of Yugoslavia
SRC	Short Rotation Coppice
SWH	Solar Water Heating
TPES	Total Primary Energy Supply
UCTE	Union for the Coordination of Transmission of Electricity
UNDP	United Nation Development Program
UNFCCC	United Nations Framework Convention on Climate Change
UNIAMK	United Nations Interim Administration Mission in Kosovo.
USAID	United States Agency for International Development

1. Introduction

The main purpose of this Master Thesis is to assess the potential of renewable energy in Montenegro and to analyze the current status of policies and support schemes as well as the legal framework. Montenegro plans to become a member state of the European Union within a decade and therefore it has to undertake severe efforts in order to implement EU Directives for the achievement of the 2020 energy and climate target.

1.1. Objectives of this Work

The objectives are an in-depth analysis of the unexploited potential and existing use of RES and an assessment of current investment opportunities with a focus on economic, administrative and legal issues. Montenegro has received EU candidate status in 2010 and EU policies on energy will play a dominant role in the future. EU´s energy objectives like energy security, energy efficiency and energy independency will certainly influence the country´s energy agenda.

This thesis is divided into three different sections, whereat in the first part the economic, geographical, legal and administrative situation of Montenegro in accordance with renewable energy is discussed. Also the EU and its impacts on policies as well as the European perspective as a whole are outlined in this part. Montenegro aims towards a 30% RES target in 2020, but on the other hand the country is also a huge consumer of energy and currently needs to import approximately one third of its power needs. The country´s energy intensity is 40% higher than the average of European OECD countries, primarily due to the large aluminum smelter KAP in Podgorica, which is also analyzed in this Master Thesis. Energy efficiency and energy saving are also containing a huge saving potential that could be utilized and which accounts for 20%-30% of total current energy needs. Generally speaking it can be stated that the energy sector in Montenegro is characterized by high-energy intensity in comparison with the European Union and other developed countries. As a matter of fact the RES potential together with energy efficiency provisions commonly offer a promising opportunity to be developed and invested in.

The second part of the thesis deals with an in-depth analysis of three different renewable energy systems, namely hydro power, wind energy and biomass. The accurate status quo and potential will be elaborated as well as deployment possibilities. Long run generation costs will be calculated and compared with the current support schemes for RES. Additional to these three renewable energy sources, the potential of solar energy, biofuel and municipal solid waste will be analyzed.

In the third part of this thesis the above analyzed information and results are compared with the Hungarian RES market in accordance with the study “Renewable Energy Industry Roadmap for Hungary”. The experience gained in the Hungarian case could be useful for Montenegro and proposals for future provisions and agendas will be presented.

The conclusion will define a future energy strategy for more efficient and sustainable RES-deployment and developments in Montenegro.

1.2. Method of Approach

In order to elaborate a comparative analysis of the Montenegrin RES market and the country´s potential it is necessary to undertake an in-depth analysis of the current situation. This status quo analysis was done by applying existing data and studies provided by the Ministry of Economic in order to gain more reliable answers for the accurate potential evaluation. Also existing energy strategy papers of this Ministry and research papers of the Energy Community were taken into account. Besides that EU policies and directives were examined. Influencing factors like tourism, the impacts of the Podgorica based aluminum smelter KAP, the accurate and actual forest potential, the real use of biomass among other things were monitored for better performance accountability and for adjustments of a country wide energy strategy. Then a research was done with existing and gained data on support scheme proposals in order to measure economic effectiveness of investments into this market. Goals and objectives were to collect a broad range of data from diverse influencing factors through a series of objective analysis. Through this errors of previous researches and studies were uncovered and a countrywide energy strategy was possible to be drafted.

1.3. Key Literature

The literature cited in this study is mainly about Montenegro´s future energy strategy in the field of renewable energy sources and related investments. Literature was retrieved from the internet, at which the majority originated from the Montenegrin Ministry of Economic (http://www.oie-cg.me). This Ministry mainly provides information about studies in the field of renewable energy sources (biomass, hydro power and wind), strategy papers for future developments in the energy sector in general and legal documents and procedures about investments into the energy market. Another main source was the website of the Energy Community (http://www.energy-community.org) offering studies, presentations and strategy papers of its member countries. Through this website it was possible to undertake comparative analysis and observe different aspects in the field of renewable energy sources and related issues of non-EU member countries.

2. Country Overview

In 2006, Montenegro declared its independence from Serbia, following a referendum carried out amongst the Montenegrin population. The country's economy is largely depending on tourism and real-estate related investments. Montenegro´s GDP grew 10.7% in 2007 and 7.5% in 2008, but declined due to the global financial crisis in 2009 and 2010. Since 1991 Montenegro is an ecological State which is also determined in the Republic´s Constitution.

Renewable energies, such as hydropower, biomass, wind energy, geothermal, solar, and ocean energy are playing an increasingly important role within the energy policy framework of the European Union. In particular future EU member states are assessing their renewable energy portfolio with regard to energy security, reduction of fossil fuel dependency and greenhouse gases as well as environmental protection. Montenegro is also member of the Energy Community and since December 2010 a Candidate Country of EU.

The International Energy Agency (IEA)'s world energy outlook contains the following important quote in the 2009 fact sheet: "Why is our current energy pathway unsustainable?" (IEA, 2009):
"*Global energy use is set to fall in 2009 — for the first time since 1981 on any significant scale — as a result of the financial and economic crisis, but demand is set to resume its long-term upward trend once the economic recovery gathers pace. By 2030, the Reference Scenario, which assumes no change in government policies, sees world primary energy demand 40% higher than in 2007*."

Due to future social and economic developments in Montenegro the Government is forced to focus on the development and deployment of RES in order to meet the increasing energy demand and the goals for the 2020 EU energy agenda. RES will play an important role in energy supply and for energy security reasons, but partly also in the field of energy efficiency (CETMA, 2007). In particular tourism industry will require a huge share of the available energy in order to meet peak demands during the summer season and to support Montenegro´s development towards a service driven economy.

2.1. The Territory of Montenegro

The Republic of Montenegro extends over an area of 14,026 km² with internal waters and steep terrains, mostly covered by forests, crops and pastures. The Northern region is covered by mountains with highest peak Bobotov Kuk in the Durmitor range with an elevation of 2.522 m. The only area with a relatively large flat extension is located around Podgorica, the capital of Montenegro. Next to it is also located Lake Skadar, 40 km away from the sea, containing the largest fresh water body in the Balkans with a surface of 391 km² (CETMA, 2007).

The usage structure of the total territory of Montenegro is divided into: agricultural land with 5.140 km² or 37% of territory; forests with 6.622 km² or 45% of territory, and settlements, roads, rocky areas and other categories in the size of approximately 2.442 km² or 18%. Currently there is only 741 km² of high quality agricultural land available, which accounts for 5,4% of total territory. Regarding the level of forest density (45%) compared to other former Yugoslavian republics a higher forest density level is only obtained by Slovenia with 50%. Among European countries only Finland (75%) and Sweden (56%) have higher forest densities (Spatial Plan of Montenegro, 2007). However, these figures have to be evaluated cautiously, because forest maps with accurate data do not exist and forests are sometimes registered twice.

FIGURE 1: MAP OF MONTENEGRO, Source: CETMA, 2007

2.2. Economic Situation

The current economic situation, 5 years after the country´s independence, can best be reflected by the global competitiveness report. The stage of development of the Montenegrin economy is described as efficiency-driven (World Economic Forum, 2010). Most of the country´s economic activities are heavily depending on tourism and real estate related business and the impacts of the global financial crisis can still be observed. A recent International Monetary Fund (IMF) assessment and analysis recommends an adjustment of economic policies. However, investments into RES are based on a long term strategy and are rather depending on an attractive energy policy framework that among other things also defines appropriate support schemes and a secure and stable business environment. The IMF world economic outlook for Montenegro for the years 2011 and 2012 forecasts a positive gross domestic product (GDP) growth of 2 % for 2011 and 3,2% for 2012 (IMF, 2011).

In general it can be stated, that RES investments provide besides an alternative energy supply source also a huge potential to boost the country´s economy. In particular in countries with weak or non-existing modern infrastructure like Montenegro, green field investments into renewable energy projects contribute to a high extent to GDP growth, poverty reduction and the creation of jobs and businesses.

3. The Energy Sector of Montenegro

The energy sector of Montenegro severely suffered during the Balkan Wars and was since then not modernized. Therefore most of the sector´s existing infrastructure needs to be modernized and partially renewed mainly by foreign direct investment (IEA, 2008).

Montenegro currently imports approximately one third of its power needs. The power supply situation in Montenegro is anticipated to continue tightening significantly.

The following statistic was retrieved from the website of ERRA (Energy Regulators Regional Association), which shows data for 2009 with a size of population of 645.000 and a GDP per capita of € 4.908:

TABLE 1: KEY STATISTICS OF MONTENEGRO FOR 2009

Key Statistics (2009)	
Population	645,000
GDP/Capita	EURO 4,908
Generation	2.679 GWh/year
Electricity Market Size	3.720 GWh/year
Surplus Installed Capacity over Demand	No
Net Electricity Importer	1.050 GWh
Natural Gas	No natural gas. Neither production nor facilities

Source: ERRA, 2010

Currently Montenegro mainly uses hydropower and indigenous lignite as domestic sources of energy (IEA, 2009). Lignite is the most important domestic energy source, accounting for 32 % of the total primary energy supply. It is produced in two mining areas, Pljevlja and Berane. Two offshore oil exploration blocks off the Montenegrin coast are held by Jugopetrol, which is owned by the Hellenic Group of Greece (Kindermann Loncarevic, A. et.al., 2010). Alongside with hydropower indigenous lignite are main domestic sources of energy. Montenegro has a total installed capacity of 868 MW, of which almost 75% originate from two large hydro generating power plant and approx. 24% from a single coal fired power plant (Markovic., M. 2009).

Further potentials for energy generation provide biomass, solar energy and wind energy. There is currently no use of wind energy and solar energy is partly used by private households and hotels for warm water heating only, but without any remunerations or subsidies. Geothermal and ocean energy would provide a certain potential, but will not be elaborated in this Master Thesis, since no profound data are available. Currently there is no production of biodiesel or bioethanol and the production of natural gas does not exist. A huge saving potential could be generated through energy saving, respectively energy efficiency, which accounts for 20%-30% of current total energy needs. For achieving this aim sever regulations and provisions for the building sector need to be implemented (IEA, 2009).

Montenegro's energy intensity is 40% higher than OECD average in Europe, primarily due to the large aluminum smelter in Podgorica, which plays a main role in the Montenegrin energy sector.

The energy sector in Montenegro is still mainly in the ownership of the State and is currently composed of the following holding companies:

• Electric Power Company of Montenegro, Holding Company – Nikšić (EPCG)

• Coal Mine, Holding Company - Pljevlja

• Brown Coal Mine, Holding Company, "Ivangrad" - Berane

• "Jugopetrol", Petrol Holding Company – Kotor, owned by Hellenic Group Greece

• "Montenegro Bonus" - Cetinje

Further privatization efforts can be expected, but a main obstacle to this is the unbundling of the Montenegrin energy sector, which has to take place first.

3.1. Power Utilities

Elektroprivreda Crna Gora (EPCG) is the power utility company of Montenegro. On 30 December 2008 the Energy Regulatory Commission adopted a decision on opening the electricity market on 1 January 2009 which led to the partial privatization of EPCG (EBRD, 2008).

In order to prepare for privatization of EPCG the vertically integrated entity was separated and functionally unbundled by moving most of its activities to a completely independent newly founded company called Prenos. Prenos will carry out through licenses the activity of a transmission network and a market operator. The State owns around 71% of Prenos shares, the remaining part is owned by private entities.

EPCG remained as vertically integrated electricity company with three functionally unbundled activities: generation, distribution and supply. In 2009 the Italian company A2A became owner of 43.7% shares of EPCG, the State of Montenegro remained majority stockholder with 55% (Energy Community, 2009).

The new Energy Law, which regulates among other issues the requirement of legally unbundling the current system, was put in force April 2010 (Energy Law, 2010). By law the market also has to be opened to end-users by 2015 (ERRA, 2010).

In 2009 A2A had won a tender to buy 18.3 percent stake in EPCG, beating a higher bid from Greece's public power corporation and then purchased through several steps shares from EPCG through the Montenegrin stock exchange. The Italian investor plans to invest up to € 5 billion in energy projects and infrastructure in Montenegro through its power grid operator Terna (TRN.MI) (Komnenic, P., Sekularac I, 2009). The unclear tender process, where A2A outperformed a higher bidder, led to sever critics in the media, but had no legal consequences.

Italy's power grid operator Terna will build the 100 kilometer-long underwater cable with a 1,000 MW initial capacity. The power cable should alleviate electricity shortages in both countries. According to the Ministry of Economic Montenegro will obtain a 20% share in this power cable investment, which will also significantly improve the power grid and the country could become a major energy hub in the region. The deadline for the completion of the underwater cable is 2013 and the overhaul of the power grid is due by 2015 (Reuters, 2010). Joint projects like this are favored by strategy papers of EU and the Energy Community. This project entailed many critics since the privatization of EPCG, the domestic power utility company, was accomplished hand in hand with this cable investment project.

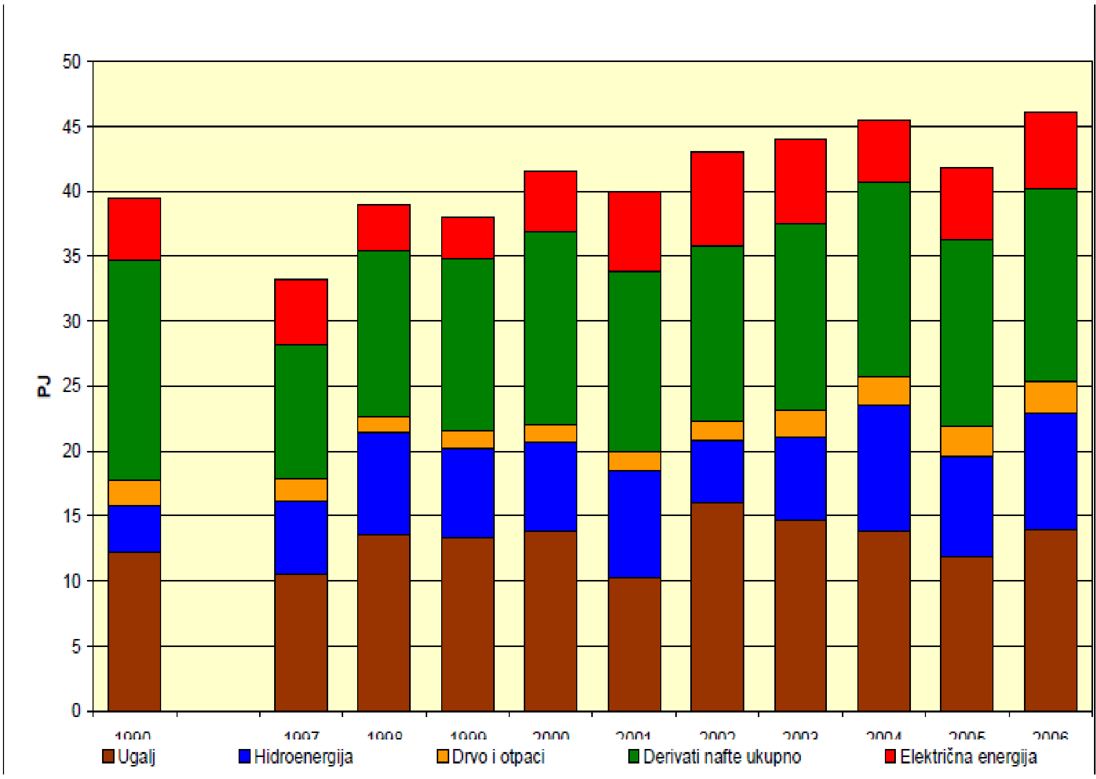
TABLE 2: OWNERSHIP STRUCTURE OF EPCG

Ownership structure of EPCG	
Share Holders	**100%**
State of Montenegro	55,00 %
A2A	43,70 %
Private Ownership	1,21 %
Other Legal Entities	0,09 %

SOURCE: EPCG, 2010

3.2. Energy Balance

The energy balance of the period 1997-2006 shows the following results regarding the share of RES in primary energy consumption:



* **Legend:** Ugalj – **Coal**; Hidroenergija – **Hydro energy**; Drvo i otpaci – **Wood and wooden waste**; Derivati nafte – **Oil derivate**; Električna energija – **Electricity from imports**

FIGURE 2: ENERGY BALANCE 1997-2006 FOR PRIMARY ENERGY CONSUMPTION
Source: Markovic., M. 2009

The main source of domestic primary energy during the period 1997-2006 was hydro (blue) and coal lignite (brown). The total consumption of primary energy in 2006 was 46.11 PJ (100%), which equals 12.808,33 GWh. Out of the total energy consumption the biggest share belongs to oil derivate (32.3%), then coal (30.1%), hydro energy (19.6%) and wood (yellow) with 5.3%. It means that the share of renewable energy sources for primary energy in total consumption is 24.9%, which is higher than what was decided as a strategic goal for EU and its member countries all together until 2020 (Markovic., M. 2009).

Montenegro currently imports approximately one third of its power needs. The power supply situation in Montenegro is anticipated to continue tightening significantly.

The import/export balance by energy source in 2008 for Serbia and Montenegro shows the following result: (all units in TJ):

TABLE 3: ENERGY BALANCE FOR SERBIA AND MONTENEGRO 2008 IN TJ

TJ	SOLID FUELS	CRUDE OIL	OIL PRO-DUCTS	GAS	HYDR. NUCL.	ELEC.	HEAT	BIO-MASS	TOTAL
PRIMARY PRODUCTION	331,631	26,911		9,691	34,014			37,928	**440,176**
IMPORT	39,952	105,774	66,012	76,647		32,734			**321,120**
EXPORT	-1,908		-2,581			-33,043		-4,193	**-41,725**
PRIM. CON-SUMPTION	370,545	132,685	63,431	86,338	34,014	-309		33,735	**720,440**
FINAL CON-SUMPTION	50,948		157,759	60,638		95,331	40,583	33,491	**438,750**
INDUSTRY	32,119		29,159	34,359		24,265	20,044		**139,947**
TRANS-PORT	8,95		102,387			917			**103,313**
HOUSE-HOLD SERVICES	18,819		4,967	9,296		70,149	20,539	33,491	**157,261**
NON ENERGY USE			21,246	16,984					**38,229**

Source: enercee.net, 2011

There is no separate statistic for Montenegro´s balance only retrievable, therefore it roughly can be estimated, that 10% of each figures would represent the value for Montenegro. However, there is no nuclear power plant in Montenegro and the country also does not export electricity, nor does it produce gas. These data mainly refer to Serbia. Fossil energy sources are main components for energy production in both countries. Biomass and hydropower are still underrepresented as is heat production, which applies for both countries.

3.2.1. Energy Production by RES

Montenegro has currently installed the following capacity of RES:

2 licenses for wind parks in Krnovo and Mozura with a future installed capacity of 96 MW are already contracted but not yet realized (Energy Community, 2010; Day of Montenegro in the Energy Community).

The biomass figure relates to the use of fuel wood in households and is listed in this table because almost 40% of Montenegrin households are using fuel wood for heating and also partly for cooking.

TABLE 4: ENERGY PRODUCTION FROM RES IN MONTENEGRO IN 2010

	RES ENERGY PRODUCTION IN 2010
Hydropower*	*2,062 GWh*
Biomass / Fuel wood*	*670,25 GWh*
Solar Thermal**	*5 GWh*
TOTAL GWh	**2,737,25 GWh**

Sources:
*Energy Community, 2010: Study on the Implementation of the New EU Renewable Directive in the Energy Community, 658 MW total installed capacity with average load factor of 35% for small and large scale hydro power plants.
**LUX Development, 2010
*** Source: Kovacevic, I. 2010: Renewable energy sources in Montenegro, Investing in Energy Efficiency and Renewable Energy

3.2.2. Energy Consumption

TABLE 5: CONSUMPTION OF ELECTRICAL ENERGY AND FOSSIL FUELS

ENERGY STRUCTURE	UNITS	2006	2007	2008
ELECTRICAL ENERGY	**GWh**	4,684.8	4,646.7	4,585.0
DARK COAL	**T**	2000	2000	n.a.
LIGNITE	1000t	28	27	29
OIL	1000t	26	14	15
FUEL OIL	1000t	112	110	115
LIQUID GAS	1000t	1	3	2

Source: Nikcevic V, 2010

The following figure shows the structure of final energy consumption by sector in the period 2002 to 2006 in the iron and steel industry as main consumer of 43%. This consumption is mainly caused (40%) by the privatized aluminum plant KAP:

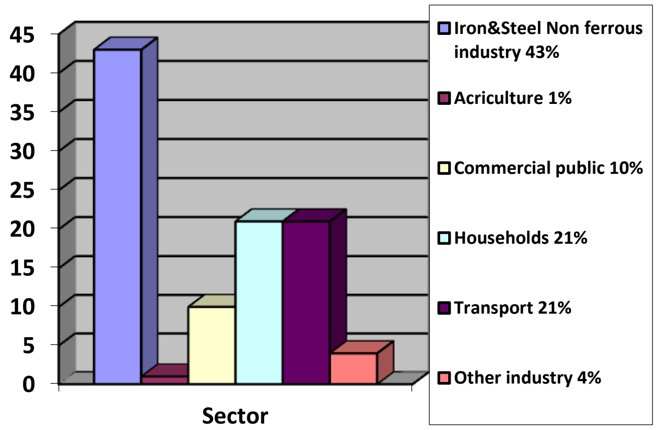


FIGURE 3: STRUCTURE OF AVERAGE FINAL ENERGY CONSUMPTION BY SECTOR 2002-2006
Source: Pavlovic, B. 2010

Figure 4 shows the distribution of consumption of petroleum products where iron and steel industry (41% - KAP 32%) and transport sector (46%) are the main consumers:

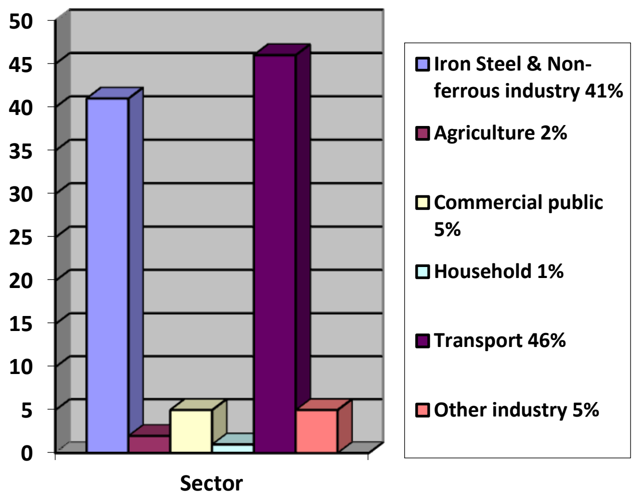


FIGURE 4: STRUCTURE OF AVERAGE FINAL ENERGY CONSUMPTION OF PETROLEUM PRODUCTS 2002-2006,
Source: Pavlovic, B. 2010

In figure 5 is presented the structure of final energy consumption of electricity during the period 2002-2006 with the iron and steel industry as main consumer with 55% (KAP 50%), followed by households with 28%:

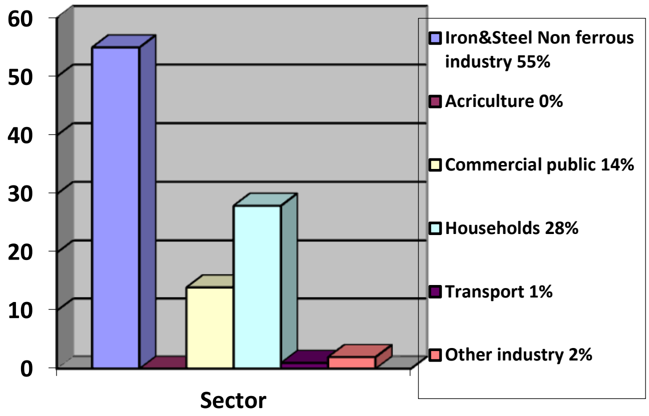


FIGURE 5: STRUCTURE OF AVERAGE FINAL ENERGY CONSUMPTION OF ELECTRICITY 2002-2006
Source: Pavlovic, B. 2010

3.2.3. Electricity Demand and Use

Import and export of electricity is under responsibility of EPCG whereat the country has to import approximately 30% of its electricity (Energy-Community, Energy Institute Hrvoje Požar, 2010).

The following figure shows the production, consumption and the balance for electricity of Montenegro during the period 1990 and 2004. In 1996 production and consumption were counterbalanced, but since 1997 consumption and production are drifting apart towards a negative balance:

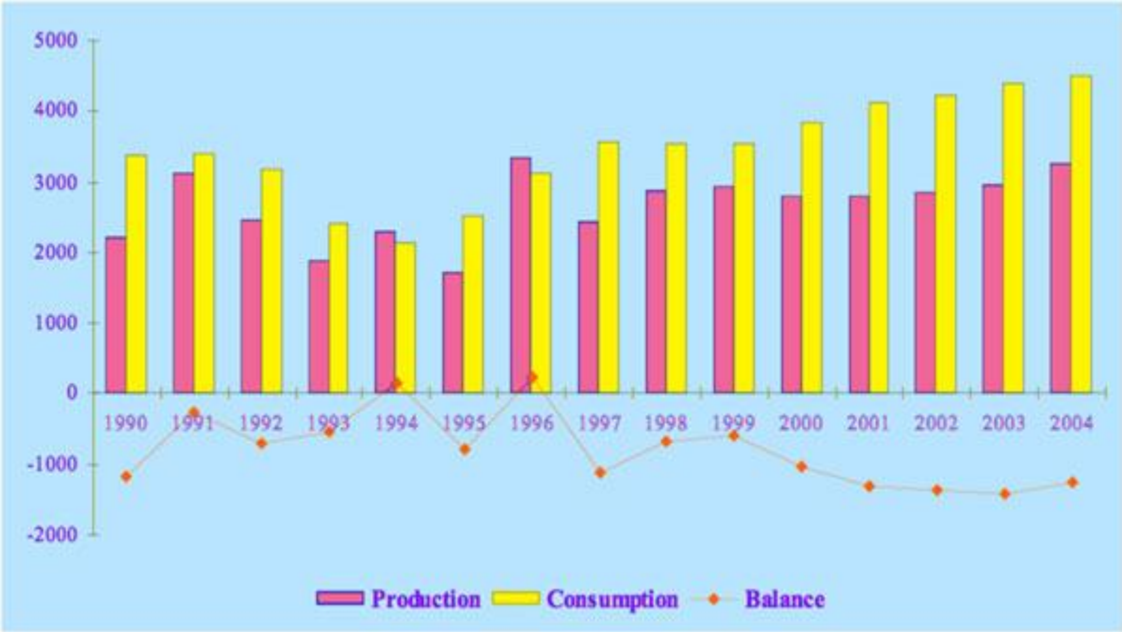


FIGURE 6: PRODUCTION, CONSUMPTION AND BALANCE OF ELECTRIC POWER OF MONTENEGRO 1990-2004
Source: USMNEBC, 2007

3.2.4. Electricity Production

Montenegro has a total installed capacity of 868 MW, at which 75% is generated from two hydro power plants and 24% from a single coal fired power plant. All three plants were built between 1977 and 1981. Seven small hydro power plants, with capacities of 10MW or less contribute only 1% respectively 9 MW of installed capacity (Markovic., M. 2009).

TABLE 6: INSTALLED CAPACITY OF GENERATION AND ELECTRICITY PRODUCTION OF ELECTRIC POWER SYSTEM

Type	Installed capacity		Net capacity	
	MW	*%*	*MW*	*%*
Small Hydro Powers (7 in total)	*9.0*	*1.0*	*9.0*	*1.1*
Large Hydro Power Plants:				
Piva and Perucica	*649.0*	*74.8*	*649.0*	*76.2*
Thermo Power Plant *Pljevlja*	*210.0*	*24.2*	*193*	*22.7*
TOTAL CAPACITY	**868**	**100.0**	**851.0**	**100.0**

Source: Markovic., M. 2009

Demand for power fell during the 1990's due to the Balkan Wars and therefore no new generating capacity was planned. Since the mid-1990s the demand for electricity has begun to grow again and in 1994 total final consumption was 505 GWh, while in 2005 it accounted for 2,077 GWh. Most of this growth in demand comes from the residential sector, because Montenegro experienced a doubling in demand from the residential sector over the last 20 years and an increase in tourism capacity (Markovic., M. 2009).

In Montenegro there are currently 10 energy generation plants installed: two large scale hydropower plants, one thermal power plant and 7 small-scale hydro power plants. The total capacity is 868 MW and the combined production of all power generation facilities amounted to approximately 3,200 GWh (71% of consumption) in 2005. In the same year a further 1,300 GWh (29% of consumption) had to be imported for the amount of €40 million, which resulted in energy cost for imported power of 30,78 €/MWh (CETMA 2007).

TABLE 7: POWER GENERATION IN MONTENEGRO PER AMOUNT AND TYPE IN GWH 1998-2004:

GWh / YEAR	HYDRO Power Plants	THERMO Power Plants	TOTAL	GENERATION in % of Consumption
1998	1709	855	**2584**	72,37
1999	1693	24	**2617**	61,69
2000	1579	951	**2530**	6,09
2001	1768	647	**2415**	58,64
2002	1096	1099	**2195**	51,87
2003	1532	1074	**2606**	59,32
2004	2231	955	**3186**	70,64

Source: CETMA, 2007

The planned production for 2009 was 2,766 GWh and achieved were actually 2,679 GWh or 96,9% of the plan.

TABLE 8: ELECTRICITY PRODUCTION IN 2008 AND 2009 IN DIFFERENT GENERATION SECTORS:

	HYDROELECTRIC POWER	**THERMAL POWER**	**TOTAL**
2008 (GWh)	1.523	1.176	**2.699**
2009 (GWh)	2.062	617	**2.679**
2008/2009 (%)	135,39	52,47	**99,26**

Source: EPCG, 2010

3.2.5. Electricity Consumption

The following table shows the total power consumption in Montenegro for the period 1998 to 2004, which is constantly rising since 2000:

TABLE 9: POWER CONSUMPTION IN MONTENEGRO PER VOLTAGE LEVEL IN GWH

YEAR	**Direct Cons. on 110 kV**	**Consum. on 35 and 10 kV**	**House-holds**	**Others on 0,4 kV**	**Distrib. Losses**	**Trans-mission Losses**	**TOTAL**
1998	1581	263	940	223	409	127	**3543**
1999	1511	243	965	957	417	149	**4242**
2000	1711	256	1112	278	321	150	**3828**
2001	1886	344	1101	286	347	155	**4118**
2002	1999	373	1053	293	359	155	**4232**
2003	2025	363	1079	308	446	172	**4393**
2004	2105	332	1059	320	501	193	**4510**

Source: CETMA, 2007

The following table of EPCG, the national power utitlity company, shows the consumption of electricity in 2009, but also indicates high distribution losses:

TABLE 10: ELECTRICITY CONSUMPTION IN 2009

CONSUMPTION in 2009	UNIT
Consumption Category	kWh
Direct Consumers (110 kV)	1.106.485.429
Consumers at 35 kV	71.098.753
Consumers at 10 kV	234.899.842
0.4 kV Level	126.561.195
0.4 KV Level II	246.253.591
Distribution Losses	570.011.000
Transmission Losses	147.537.000
TOTAL kWh	**3.757.425.000**
TOTAL GWh	**3.757,425**

Source: EPCG, 2010

Transmission and in particular distribution losses are very high, a common issue in transition countries. As a matter of fact foreign investors are always welcomed when investing into infrastructure projects and when introducing clear and effective billing measures.

The following figure shows the electricity consumption of households in Montenegro:

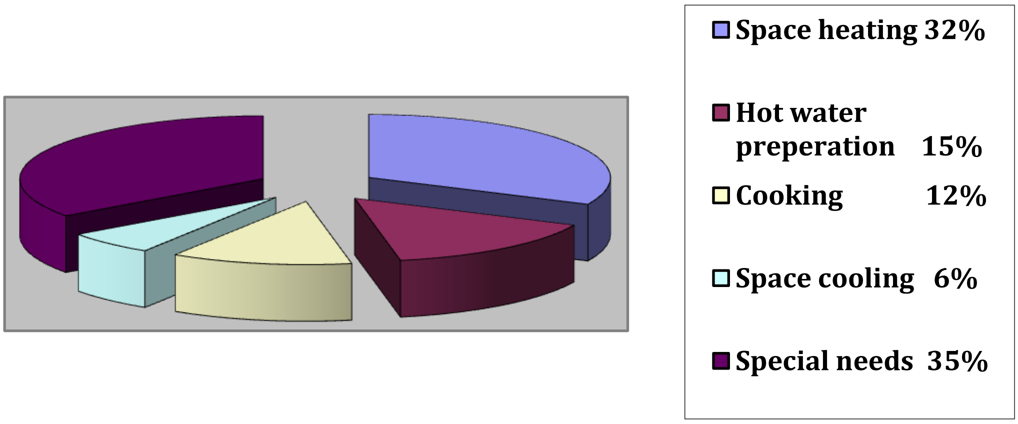


FIGURE 7: ELECTRICITY CONSUMPTION OF HOUSEHOLDS IN 2009
Source: Jablan N., 2010

Space heating 32% and hot water preparation 15% with a total share of 47% of electricity consumption for households could be replaced by thermal solar heating systems.

3.2.6. Inbound Tourism and Future Development

The future development of tourism is not included in Montenegrin energy strategy papers about energy use, consumption and supply. According to data of Monstat, the official Montenegrin Statistical Office, in 2009 there were altogether 1.207.694 tourists visiting Montenegro with total overnight stays of 7.552.006 (6,25 days on average per tourist). In 2010 1.262.985 tourists in total were visiting Montenegro with overnight stays in the total amount of 7.964.893 and an average stay of 6,3 days per visiting tourist. (Monstat, 2010). If we make a projection on a yearly basis for 2009 (7.552.006 / 364,5) 20.718 additional consumers on a yearly basis have to be calculated for energy consumption. However, when we break down this figure into the actual peak season of 3 months in summer (7.552.006 / 364,5 /30,5* 3) additional 210.656 consumers have to be taken into account for 2009 and for 2010 (7.964.893 / 364,5 /30,5* 3) 222.173. This figure accounts for an additional 1/3 of the Montenegrin population.

TABLE 11: INBOUND TOURISM AND PEAK SEASON PROJECTION FOR 2009 AND 2010

	2009	**2010**
Number of Tourists	1.207.694	1.262.985
Average Stay in Days	6,25	6,3
Yearly Projection	20.718	21.852
Peak Season Projection	210.656	222.173

Source: Monstat, 2010

This means, that any strategy on future energy consumption and supply, as well as water use and waste disposal has to calculate for the 3 months period of peak season an additional 1/3 of consumers coming from inbound tourism.

In a study about future tourism in Montenegro conducted by the Ministry of Tourism in 2008 it is even stated, that grey tourism is estimated to be two times more, than official figures state (Ministry of Tourism, 2008). In the meantime more control mechanisms have been implemented, but even if grey tourism turns into official tourism, the energy supply, waste collection and water supply systems will not be provided immediately. Until today there is no concrete strategy paper existing for a countrywide solution. Another problem is the lack of a common sense among municipalities, which reflects a very typical Montenegrin situation, namely

that single municipalities obtain for such a small State too much decision power.
According to this study of the Ministry, Montenegro plans to achieve in 2020 **39.605.000** overnight stays, which is almost 5 times more than the result of 2010 (Ministry of Tourism, 2008). This would account for another million of consumers for the 3 months peak season. Currently many tourism resorts, like Budva by example, lack of permanent water and power supply during the peak months in summer.

3.2.7. The KAP Case

A main role within the energy sector plays KAP, the Podgorica based aluminum smelter, which was after its privatization purchased by Russian investor Oleg Deripaska.
When analyzing the energy, electricity and fossil fuel consumption it is important to review the consumption of KAP and its share in final energy, electricity and fossil consumption:
The privatized aluminum smelter, which inhabits a predominant share in final energy consumption of 40 %, a 50 % share of the total final electricity consumption and a 32 % share of the fossil fuels final consumption, requires a solution and decision by the Montenegrin Government.
Therefore it is important to analyze what does it mean for Montenegro´s energy balance when energy consumption of KAP is included or excluded in the calculation of the National Energy Saving Target:

TABLE 12: FINAL ENERGY CONSUMPTION FEC IN KTOE

	Average 2002- 2006	**Target**	**Savings**
FEC in ktoe	672,2	9%	60,5

Source: Pavlovic, B. 2010

First of all KAP cannot achieve significant energy savings in FEC due to technology constraints and the plant also has an instable, questionable future. The inclusion of KAP in the calculation of the National Target of 9% practically means that all other consumers have to meet an actual target up to:

- 15,7% assuming that KAP does not achieve savings, respectively
- 13,5 % assuming that KAP achieves 3% savings

At the side of the Montenegrin Government there is a tendency to exclude KAP from the calculation of the National Energy Saving Target, even though the plant is still in operation (Pavlovic, B. 2010).

A calculation without KAP simply looks better, but the question with or without KAP is rather a political than an economical one. KAP is a major employee in Montenegro, both directly and indirectly. 5.000 workers and their families are living from this smelter and they also represent an important voter potential. However, with the process of being a candidate country of EU there might arise some pressure from Brussels to shut down the plant due to significant environmental problems and energy saving reasons. The KAP case calculation is also an issue regarding the EU energy and climate target for 2020. Montenegrin officials tend to present figures without the KAP case, which seems to be an indication that in the long run this aluminum smelter will be closed down.

3.3. Electricity Prices

The average energy price for electricity for households was about 8.52 €Cent/kWh in 2009, which is in comparison to other European countries very low.

The demand for electricity per household in Montenegro accounts for about 4.800 kWh/year, which represents compared to other European countries a very high level (e.g. Germany has an average of electricity demand per household of approximately 3.500 kWh/year). Therefore energy saving, respectively energy efficiency aspects are of main importance for the future energy saving strategy of Montenegro (CETMA, 2007).

The following tables compare electricity prices among Montenegro, Croatia and Serbia. Montenegro and Serbia have experienced the greatest increase on average in electricity retail prices during the period 2007 to 2009. Montenegro 70%, Serbia 45% and Croatia 29%, but Croatia already started from a higher price level in 2005.

TABLE 13: AVERAGE RETAIL PRICES FOR ALL CUSTOMERS €C/KWH

YEAR / €c/kWh	2005	2006	2007	2008	2009
Montenegro	4,7	5,33	6,91	7,12	7,97
Croatia	7,12	7,33	7,33	8,17	9,20
Serbia	3,39	3,88	4,62	5,28	4,91
Austria*					19,71
Greece*					11,43

Source: Energy Community 2009, Electricity Prices and Tariffs in the Energy Community 2008 – 2009, Source*: E-Control, 2009

Additional are also listed the prices for Austria and Greece, which show in comparison the really low prices per kWh of Montenegro, Croatia and Serbia.
Commercial customers generally pay more than other customers, especially in Montenegro where the average price for commercial customers is particular high. These customers have to subsidize the low prices charged for electricity sold to the aluminum plant KAP, which are guaranteed by the State until 2012. Since tariffs are priced in € exchange rate differences should also be considered as influencing factor for Serbia and Croatia. Montenegro´s official currency is the €.

TABLE 14: 2009 PRICES BY CUSTOMER TYPE €C/KWH

SECTOR / €c/kWh	INDUSTRIAL	COMMERCIAL	RESIDENTIAL
MONTENEGRO	4,88	16,9	8,52
CROATIA	7,89	9,80	9,52
SERBIA	4,25	6,56	4,67
GERMANY*	11,31	-	22,82
SLOVAKIA*	14,23	-	15,40

Source: Energy Community 2009, Electricity Prices and Tariffs in the Energy Community 2008 – 2009; Source*: Goerten, J., Ganea D., 2009

Montenegro has specific tariffs for certain industrial sectors and for 2007 the prices were indicated as follows:

- Aluminum plant electrolysis: 2.88 €c/kWh
- Steel industry: 6.01€c/kWh
- Railway transportation 5.98 €c/kWh

The value of the tariff charged for the aluminum plant KAP is showing a clear governmental support for this industry. The aluminum plant represents a significant part of the country’s overall GDP, but also negatively contributes to energy efficiency and the 2020 energy and climate targets (Energy Community, 2009 -

Study on Tariff Methodologies and Impact on Prices and Energy, Consumption Patterns in the Energy Community, 2009).

TABLE 15: 2009 TRANSMISSION TARIFFS

€c/kWh COUNTRY	TARIFFS
MONTENEGRO	0,55
CROATIA	0,99
SERBIA	0,28

Source: Energy Community, 2009, Electricity Prices and Tariffs in the Energy Community 2008 – 2009

TABLE 16: 2009 DISTRIBUTION TARIFFS

€c/kWh COUNTRY	TARIFFS
MONTENEGRO	3,90
CROATIA	2,69
SERBIA	n.a.

Source: Energy Community, 2009, Electricity Prices and Tariffs in the Energy Community 2008 – 2009

3.4. The Montenegrin Power Grid

The energy system of Montenegro was part of the integrated energy system of the former Social Federal Republic of Yugoslavia (SFRY) and it was constructed as a whole system to serve several countries within the former SFRY. The transmission grid became operational in 1956 and the network of Montenegro is largely integrated with the one of Serbia and Bosnia and Herzegovina. The upgrading and automation of the power grid used to be of low quality compared to developed countries. This has been improved in the last few years but the network losses are still high, namely up to 25%, especially in distribution. The modernization and extension of the electricity grid is necessary due to old generation plants and inefficient transmission and distribution networks, but also to prepare it for RES deployments. (Energy Community, 2009: Electricity Prices and Tariffs in the Energy Community 2008 – 2009).

The major electricity network of 400 kV, 220 kV and 110 kV was built together with a transmission network that supplies almost all urban areas of Montenegro with electricity. Only some hardly accessible villages in middle and northern parts of the country are not covered by this network. Also the connection of the network with neighboring countries has started, like the construction of the long-distance network of 400kV between Podgorica and Elbasan (Albania) (Spatial Plan of Montenegro, 2007).

The following map illustrates the power grid of Montenegro, at which the blue squares indicate the hydropower plants in Perucica and Piva and the black square the coal fired thermo power plant in Pljevlja. The circles indicate transformer stations with different power charges:

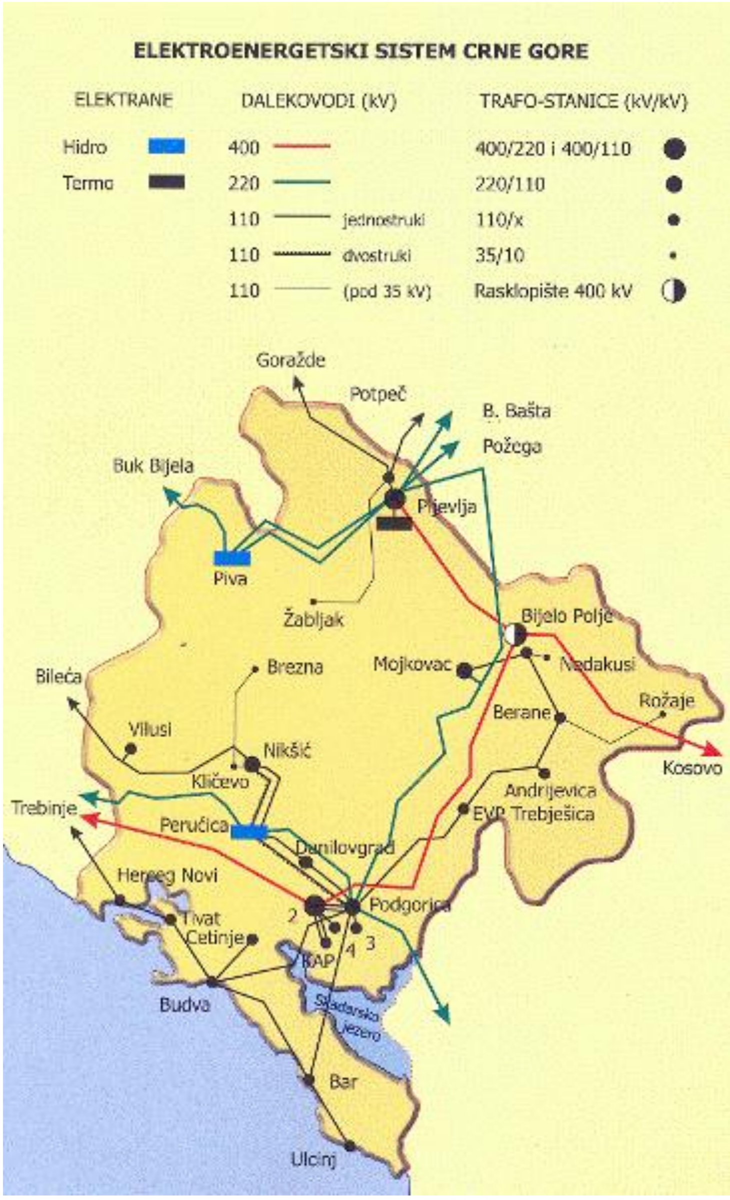


FIGURE 8: POWER GRID OF MONTENEGRO
Source: Black & Veatch (B&V), 2009

At the end of 2005 225 km of 400 kV, 348.1 km of 220 kV and 601 km of 110 kV power lines were operational and there are 16 local distribution centers supplying 285.000 consumers. Another problem besides high energy consumption, high losses in transmission and distribution network is the low level of energy efficiency and low application of energy saving material (Spatial Plan of Montenegro, 2007).

In particular for planed wind park projects, the current power grid is not sufficient and a potential wind park investment has to be evaluated in accordance with access possibilities to the existing power grid. When modernizing the power grid the construction of more underground cables will also take place as it is becoming more favorable in EU countries. This would also contribute to more protection of the environment.

3.4.1. Network Losses

Losses in the network are considered to be an inefficiency factor and Montenegro´s network generates high losses in particular in the distribution sector.

Generally it can be stated, that transmission losses are in the range typically known for EU countries from 1.5% to 2.5% according to an electricity tariff study of 2008.

TABLE 17: TRANSMISSION NETWORK LOSSES IN %

YEAR / €c/kWh	2005	2006	2007	2008	2009
MONTENEGRO	2,90	2,90	2,90	n.a.	3,68
CROATIA	2,39	2,20	2,40	2,10	2,20
SERBIA	3,36	3,04	2,97	2,79	2,68

Source: Energy Community, 2009, Electricity Prices and Tariffs in the Energy Community 2008 – 2009

TABLE 18: DISTRIBUTION NETWORK LOSSES IN %

YEAR / €c/kWh	2005	2006	2007	2008	2009
MONTENEGRO	25,96	29,06	22,80	22,50	n.a.
CROATIA	9,85	8,31	9,83	7,20	9,30
SERBIA	14,42	14,91	14,20	14,48	15,19

Source: Energy Community, 2009, Electricity Prices and Tariffs in the Energy Community 2008 – 2009

High distribution network losses also indicate poor billing and administration capacities. The costs of coverage of distribution losses reach from around 20% in the majority of cases to almost 70% of the total distribution tariff and are reflected in the distribution tariffs, which makes it difficult to have them compared among each other.

These losses are of much greater significance and are quite high, particular in Montenegro. When comparing distribution losses at EU level with 5% to 10% only Croatian distribution losses approach this level.

Transmission and Distribution losses (T&D losses) in EU are expressed in one common figure according to a webinar presentation by De Keulenaer, H. (2008): The EU25 average is 7,2%. Lowest ranking is Luxembourg with 1%, Germany with 5,2%, Austria with 5,8 %, then in the middle range is positioned Malta (14%) and at the end of this statistic Estonia (16%) with highest T&D losses (De Keulenaer, H., 2008).

Only Croatia would fall under this average EU25 statistic, however Serbia and in particular Montenegro with very high distribution losses would find their positions at the very end.

3.5. Legal Framework for (Renewable) Energy

The **"Energy Policy of the Republic of Montenegro"** was adopted in April 2005. In June 2007 the document "Energy Development Strategy of Montenegro by 2025" was prepared and implemented through the development of an "Action Plan" for the period 2008-2012.

The Energy Development Strategy of Montenegro by 2025 serves as a starting point for a European model of sustainable and strategic development of the Montenegrin energy sector and the enactment of other necessary legislation. It also supplies the institutional support for a successful implementation of Montenegro's energy policy on its way to European and broader international integrations. This strategy also includes provisions for explorations of potential small hydro power sites and a design study for wind power plant development. The strategy also works to eliminate barriers to enable utilization of renewable energy resources.

Montenegro has developed the **Energy Efficiency Action Plan 2008–2012** to promote more efficient use of energy across economic sectors. The Montenegrin "Energy Efficiency Project" finances improvements in heating systems, insulation, thermostatic valves, heat substations and networks, and other installations in buildings such as schools and hospitals (REEEP, 2009).

The Montenegrin Energy Development Strategy Paper of 2007 served as a basis for Montenegro's **Energy Law**, which was put into force in April 2010 and represents an important part of the country's energy policy. The law enables the Government the promotion of a competitive energy market and regulates generation, transmission, distribution and supply of electricity. Also energy efficiency in facilities for production, transmission and distribution of energy is regulated by the new Energy Law. It also regulates petroleum products and gas as well as the production and market for coal used in electricity generation. It does not apply to coal exploration or petroleum refining. Among other energy related activities the law also rules on the generation of energy from renewable energy sources and cogeneration (Black & Veatch (B&V), 2009).

The objectives of the Energy Law are to ensure safe, secure and reliable quality energy at fair prices. The law takes into account environmental protection, efficient use of energy, promotion of market competition, promotion of private sector participation and integration of the Montenegrin energy sector into the European Energy Market (Vujosevic, 2007).

The new Energy Law in Montenegro implemented also the new EU Directive 2009/28/EC about the promotion of use of renewable energy sources (not in transport sector) and it was put in force in April 2010 (Pavlovic, P. 2010).

The Energy Efficiency Law was prepared in 2009, adopted by Government in February 2010 and put into force in March 2010. The Energy Efficiency Law regulates energy efficiency in the sector of final energy consumption.

Both laws are in line with the Energy Community Treaty and their relevant directives (Delegation of EC to Montenegro, 2010).

The Law on Environment contains general provisions about potential economic support for projects using renewable energy sources. According to this law a strategic assessment for environmental impacts is mandatory to be undertaken for plans and programs regarding energy.

The Law on Concessions states that concessions can be granted for designing, constructing, maintaining, modernizing and using of the energy-related infrastructure for generation, transmission, and distribution of electrical energy, thermal energy and gas (Pavlovic, P., 2010).

The new Energy Development Strategy for 2025 (EDS 2025) was adopted in December 2007, the first one in Montenegro as an independent State.

The country is a party of the **Energy Community Treaty**, which entered into force in July 2006. The Treaty aims to create a regional energy market based on the rules and disciplines of the EU's internal energy market. With a small domestic market, participation in the regional Energy Community is an important way to increase energy security and also to benefit from the country's comparative advantage as a future main exporter of energy generated from hydropower. Profound energy policies are also critical to the development of Montenegro's tourism industry, which has significant potential to initiate overall economic growth.

Montenegro became an adhering Party in October 2005 that time still incorporated in the Joint Federation of Serbia and Montenegro. As of 1 May 2010, the Parties to the Energy Community are the European Union on one side and Croatia, Serbia, Montenegro, Albania, UNMIK, Bosnia and Herzegovina, Former Yugoslav Republic of Macedonia and Moldavia on the other side. The Parties have agreed to set up a legal and economic framework which entails the adoption and implementation of common agreements on energy, environment, competition and renewables. The contracting Parties have also agreed to set up a specific regulatory framework and to create institutions and rules for power trade, unbundling the energy sector and to set renewable energy generation targets. The cooperation under this Treaty will also support the integration of the region into the internal energy market of the European Community (Energy Community, 2010). The country has also ratified the Kyoto Protocol, which could further attract foreign investment and would focus on reducing the environmental impacts of the country's carbon-intensive economy.

Generally it can be stated that Montenegrin government is always eager to implement laws and puts them into force immediately, however, reality until now has proven delays, ongoing changes and lack of enforcement.

3.5.1. National Policies, Institutions and Strategies

In May 2006 Montenegro became an independent State. This move was followed with an intense period of establishing multi- and bilateral relations, speeding up the process of EU integrations, and consolidating the normative framework for internal economic development of the young State.

In Montenegro the institutional setting for RES appears fairly dispersed, because a wide range of Ministries and Agencies are being involved in the process of implementing RES schemes and deployments. This can sometimes generate problems in terms of overlapping responsibilities and streamlining of processes. The following Ministries and Agencies are involved in RES related issues:

- **Government of Montenegro**: Adoption and implementation of national energy strategy and policy.

- **Ministry of Economy**: Policy proposals, annual energy balance, energy legislation, defines pricing methodology also for grid connection, implements energy efficiency policy, develops and promotes support systems for the use of renewable energy sources.

- **Energy Regulatory Agency**: Monitors operations in the energy sector and issues licenses, sets tariffs and prices, establishes regulation and rules regarding energy market, determines the prices and tariffs, protects consumers and investor interests and regulates access to the transmission and distribution grids.

- **Ministry of Environment and Spatial Planning**: Drafts national strategies policies, laws and standards, is responsible for coordination of water supply and protected areas.
- **Ministry of Agriculture, Forestry and Water Management**: Competent for protection and monitoring the use of water resources, prepares plans for forest management, important role in energy produced from hydropower plants and biomass.
- **National Council for Sustainable Development**: Implements national strategy for sustainable development and direction of Montenegro as an ecological State.
  (Energy Community, 2010: Annual report on the implementation of the acquis under the Treaty establishing the Energy Community)

The Energy Development Strategy for 2025 is part of the overall National Strategy (Strategy for Energy Sector Development of Montenegro by 2025) with a proposed target for RES of more than 20% share in primary energy.

The Energy Development Strategy for 2025 Action Plan encourages projects related to the improvement of energy efficiency and efficiency of existing generation and transmission facilities. It also includes the increase of renewable energy sources and cleaner use of fossil fuels and the creation of a long-term strategy in economic development.

Development Strategy for Small Hydropower Plants (SHPP) includes an action plan which analyses the situation of national electricity sector where hydropower represents a significant share of electricity production (60 - 75 % depending on precipitation). Legal and institutional framework are going to be implemented, as well as operational procedures for purchase of electricity from small hydropower plants and its delivery to the Montenegrin power grid. Also the design of simplified and streamlined procedures for tendering and authorization procedures for the construction of new small hydropower plants are included.

National Strategy for Sustainable Development was designed in cooperation with UNDP, UNEP and the Italian Ministry of Environment and approved by the Montenegrin Government. Its priorities include energy and air pollution, water and forestry management, management of coastal areas, sea and sustainable tourism, energy efficiency improvements and use of renewable energy sources.

Montenegrin Energy Policy defines the objectives of energy sector and identifies instruments to achieve them, like securing reliable and diversified power supply, encouraging the use of renewable energy sources, adopting relevant legislation and regulation, privatization and liberalization of energy market.
(Energy Community, 2010: Annual report on the implementation of the acquis under the Treaty establishing the Energy Community)

3.5.2. Spatial Planning

Montenegro as part of the strategic trans-European energy networks, as defined in the European Commission Decision 1254/96/EC, will in the future have to increase the energy exchange among EU country members and remove barriers. In the area of electrical energy supply cross border connections are in the range of 7% and the goal of the EU is to establish interconnection capacities at the average of minimum 10%. Therefore the territory of Montenegro needs to be in alignment with the future energy infrastructure and its planning, which also requires space for its development (Institut za istrazivanja u energetici, ekologiji i tehnologiji, 2007).

Until today not even one planned hydro-energy facility has been realized, even though tendering procedures were finalized. The same situation can be observed with grid connection related spatial planning activities and enlargement schemes of the power grid (Spatial Plan of Montenegro until 2020, 2007).

Spatial and detail planning documents are often issued without clear regulations of ownership titles and in several cases projects were not successfully implemented. Due to unclear ownership titles lawsuits can occur which are usually lasting for an indefinite period and might even lead to the circumvention of investments in the energy sector.

3.6. Energy Efficiency

In the context of RES energy efficiency also has to be accentuated, because RES and energy efficiency are depending on each other in particular when discussing the 2020 energy and climate targets. In Montenegro the Energy Efficiency Strategy is implemented by GTZ and does include the following tasks:

Energy Efficiency Strategy includes:

- Energy efficiency in building stock
- Energy management in industry
- Use of renewable energy sources
- Rationalization and increased efficiency in transport
- Establishing energy efficiency units in Montenegro
- Regulatory and legislative changes
- International co-operation
- Reforming the energy sector

(REEEP, 2010)

A recent World Bank paper discusses the strategy for energy efficiency in South Eastern Europe. Energy consumption is evaluated to grow 100% in the industrial sector, 40% in the commercial sector and 60% in the residential sector. In order to meet the targets of 2020 and to antagonize the growing energy consumption the following strategy was suggested:

- More institutional capacity building is needed
- Governments need assistance meeting EU Directives in the field of EE
- Establish investment priorities and project pipeline
- Identify bankable cogeneration and public sector projects
- Explore designing regional energy efficiency
- Energy efficiency in the South Program that could qualify for Clean Technology Fund (CTF)
- Continue cooperation between donors and international financing institutions as World Bank, EBRD, EIB, KfW, Eastern European Task Force of Energy Community and USAID

This study also elaborates the Western Balkan´s energy efficiency saving potential in all end-use sectors:

- Transport (8-40%)
- Residential (10-40%)
- Public (30-40%)
- Service (10-40%)
- Industry (5-30%)

(Gerner F., 2009)

The study further elaborates: *"If remedial policy measures were introduced, additional average energy savings of 10-15 % of current projections could be realized"* and further in the study, *"annual energy expenditures could decrease by up to US$3.4 billion across Western Balkan countries if they could realize their estimated energy savings potential through lowering overall annual energy consumption by about 7.0 million tons of oil equivalent by 2020 (at US$65/barrel)"*.

The increased energy use in all countries and sectors will entail an annual growth of more than 3% in energy consumption throughout 2027 in case no measures are taken. Another fact is that energy prices in the Western Balkans are in almost all countries too low and residential consumers are being cross-subsidized by large industrial/commercial consumers, accompanied by relatively high commercial losses. (Energy Community - World Bank Study, 2010)

4. European Perspective

The EU is a world leader in renewable energy and contributes to the economic development and growth of EU and its member states. In 2007 a turnover of € 30 billion was generated in the field of renewable energy and additional to that 350 000 jobs were created (Directorate General for Energy and Transport, 2007).

In the last assessment of EC in December 2010 it was decided, that Montenegro will receive candidate country status and in 2011 it was announced, that negotiation date will be given in the near future. Montenegro is a member of Energy Community, which defines itself as a “process” extending the EU’s internal energy market to the South-East European region.

TABLE 19: KEY OBJECTIVES FOR THE 2020 CLIMATE AND ENERGY TARGET

By 2020 - 20% EU GHG		
By 2020 +20% Energy Efficiency		
By 2020 binding 20% renewables in final energy consumption at EU level		
RES in Transport **Min 10% binding**	**Electricity** **MS binding choice**	**Heating & Cooling** **MS binding choice**
	NATIONAL TARGETS AND ACTION PLANS	

Source: Furfari S., 2009

According to a research paper of the Energy Community support for specific forms of renewable energy generated from wind and small hydro power plants are quite well established. However, provisions for the support of renewable energy for heating and cooling are almost non-existent, with the only exception of UNMIK and to some extent in the Former Yugoslav Republic Macedonia. These countries have already implemented legal or regulatory provisions (Energy Community, 2010, Annual report on the implementation of the acquis under the Treaty establishing the Energy Community).

The same is the case with biofuels, which are part of the directive and the 2020 targets but far away from being implemented or even noticed. Also the public awareness of biofuels is not existent and it will take years to create a market for supply and demand. In a recent assessment by the Regulatory Energy Agency (RAE) the Montenegrin Government was informed, that the Energy Development Strategy is not implemented at all. Investments in the energy sector of Montenegro are way behind the action plan documented in the Energy Strategy Document of the Government of Montenegro. Also foreign experts pointed out that the scenario in the Energy Strategy of Montenegro until 2025 (in the value of about two billion €) represents a not appropriate solution and is difficult to adopt. The RAE further complains that nothing has been prepared yet even three years after the adoption of this document which expired in mid-December 2010. Also the construction of the second thermal power plant in Plevlja, which should start in 2011, is delayed. It is the same with the first concessionaires for small hydropower plants which cannot be accomplished within the timeframe envisaged in the Energy Development Strategy. Companies for construction of wind generators have been selected after a quite doubtful tender procedure and several companies have already complained at the European Commission. It is already clear that deadlines for construction of larger hydropower plants will not be met, either. According to RAE, also the electricity distribution system in Montenegro cannot meet the increasing consumption requirements (Obradovic D., 2010).

4.1. EU Directives for Renewable Energy Sources

According to the agreement with the Energy Community of South-East Europe, Montenegro is obliged to adopt EU Directives related to utilization of renewable energy resources.

The new Directive 2009/28/EC further expands the provisions for renewable energy, amending Directives 2001/77/EC on the promotion of the use of electricity from renewable energy sources and 2003/30/EC on the promotion of the use of biofuels and other renewable energy sources in transport. Directive 2009/28/EC is more detailed and lessons learnt have been incorporated whereat the European

Commission has the right to take initiatives based on the principles of subsidiarity and proportionality.

In Montenegro renewable energy sources have only recently become an issue of concern and policy. Therefore legal and regulatory bodies and institutional frameworks have to undergo a procedure of adoption and modification. Renewable energy policies have been put in place to provide a framework and indicative targets are framed and becoming more appropriate even though they are not yet consistent with the ambitions of the new EU Directive methodology.

• **Directive 2009/28/EC** was published in the Official Journal of the European Union on 23 April 2009. The Directive now integrates the areas of renewable electricity (RES_{el}), biofuels ($RES_{transport}$) and heating and cooling from renewable energy sources (RES_{th}). The previously indicative targets for the share of renewable energy sources in electricity consumption and biofuels and other renewable energy sources in transport have been adjusted and expanded to 2020 and these targets are now mandatory. Cross-border cooperation amongst member states and with third parties is explicitly encouraged through statistical transfers of RES and the development of joint projects and joint support mechanisms. (Energy Community – Annual report on the implementation of the acquis under the Treaty establishing the Energy Community, 2010). This directive was implemented with the New Energy Law of Montenegro, but not for the transport sector (Kovacevic, I., 2010).

• **Directive 2003/30/EC** on the promotion of utilization of biofuels or other renewable fuels for transport: This regulation refers to the using biofuels on the market with a share of 5.75% in total traffic until 2010.

• **Directive 2001/77**/EC on the promotion of electric energy from renewable resources on international energy market. Montenegro has prepared the plan for implementation of this directive, although there are a lot of other obstacles that have to be resolved. These obstacles are the nomination of a national target, establishment of support system and guaranties of origin, green certificates, short and simple administrative procedures and definition of conditions for attachment to the grid (Markovic., M., 2009).

4.2. Energy Efficiency Directives

• **Directive 2006/32/EC:** Energy End-Use Efficiency and Energy Services
• Directive 2005/32/EC: Eco-Design of Products
• Directive 2002/91/EC: Energy Efficiency in Buildings
• Council Directive 92/75/EEC: Energy Labeling of Household appliances

Basic energy efficiency documents are the following:

• Energy Efficiency Strategy
• NEEAP (National Energy Efficiency Action Plan)
• Local self-government energy efficiency improvement programs and plans
• Operational plans for energy efficiency improvement in public administration institutions

The sector for energy efficiency within an institutional framework was established in December 2009 by the Ministry of Economy and is called the Central Energy Efficiency Institution. In February 2010 an IPA 2007 project, called "Technical Assistance for the Implementation of the Energy Community Treaty", has commenced (Pavlovic, P., 2010).

4.3. European Funds for Energy Projects in Montenegro

4.3.1. European Commission

The "Instrument for Pre-accession Assistance", IPA, represents the key support measure of the European Commission:

- Institution building measures with accompanying investment
- Cross-border cooperation
- Regional development
- Human resources development
- Rural development

With reference to the seven contracting Parties of the Energy Community a special IPA multi-beneficiary program accompanies the national IPAs. The EU also offers the contracting Parties a new project preparation facility for infrastructural investments in the Western Balkans in order to support the preparation of investment projects.

The current EU research program, FP7 (2007-2013), sees the contracting Parties as part of the program and lists projects on renewable electricity generation as eligible. The EU Twinning Program accounts for one of the principal tools in the area of Institution Building Accession Assistance.

4.3.2. European Agency for Reconstruction, EAR

The European Agency for Reconstruction (http://www.ear.europa.eu/home/) manages on behalf of the European Commission the European Union's main assistance programs in Serbia, Montenegro, and the Former Yugoslav Republic of Macedonia and in Kosovo.

4.3.3. European Investment Bank, EIB

The EIB ((www.eib.org) cooperates closely with the European Commission, providing grants and loans in the pre-accession phase in order to guarantee financing packages. The Energy Community benefits from support for infrastructural development and technical assistance. Together with EBRD a joint multilateral Carbon Credit Fund is managed (Energy Community Donors, 2010).

4.3.4. Other Organizations

Ongoing RES-E and EE projects supported by country donors or international financial institution in Montenegro are the following:

EBRD: Energy Efficiency Facility
EBRD: Energy Audits at Big Energy Consumers

EU funded projects: IPA 2007: “Supporting the implementation of the Energy Community Treaty”, € 1.5 Mio, October 2009 – to be defined.

EU funded projects: IPF (Infrastructure Project Facility): “Energy Electricity Network Development Project”.

EU funded projects: IPA 2010: “Harmonization of National Legislation with EU acquis in the Area of Construction, including Energy Efficiency and Renewable Energy Sources on Demand Side”.

Government of Spain (Spain): Feasibility Study and Technical Design for Energy Efficiency Measures for the Clinical Center Podgorica.

GTZ (Germany): GTZ ASE Project (Advisory Services to Energy Efficiency in Montenegro), € 1,5 Mio, April 2008 –December 2010.

IMELS (Italy): The Balkan Renewable Energy Program (BALREP).

KfW (Germany): Renewable Energies and Energy Efficiency Facility Montenegro, € 15 Mio, October 2006 (revolving fund).

UNDP/ GEF: Power Sector Policy Reform to Promote Small Hydropower Development in the Republic of Montenegro, US$ 1 Mio, June 2008 – May 2012.

UNDP: Climate Change- Initial National Communication (INC) under UNFCCC, US$ 0.385 Mio, May 2008 – May 2011.

World Bank: Energy Efficiency Project in Montenegro, € 6.5 Mio, January 2009 - December 2012 (Kovacevic, I., 2009).

5. RES in Montenegro

Montenegro recognizes the importance EU gives to renewable energy and that the accession process requires harmonization of energy policies. New laws have to be enacted and current legislation has to be harmonized with EU standards in order to meet the requirements of multilateral and bilateral agreements (Markovic., M. 2009).

Montenegro has signed the multilateral agreement of the "United Nations Framework Convention" about "Climate Change" (UNFCCC) 1997 and its amendment. "The Kyoto Protocol" was ratified in 1997 and enacted in 2001. Furthermore, the Government of Montenegro signed the "Treaty Establishing the Energy Community" in October 2005 with the obligation to promote renewable energy sources (Markovic., M. 2009).

Montenegro´s potential of explorable renewable energy is outstanding and could provide a significant contribution to GDP growth and energy security.

5.1. Classification of RES

Renewable energy is separated into three different applications:

- Electricity generation
- Heating and cooling
- Biofuels for transport

The different types of renewable energies will be analyzed in detail for hydropower and wind energy, which are used for electricity generating and biomass which is used for both electricity and heat generation. In Montenegro biomass is currently only used for heating purposes. The proposed Montenegrin support schemes for RES are in the moment discussed for hydro power plants, wind parks and biomass as feed-in-tariff schemes. Biofuel is not yet elaborated, only discussed. Together with municipality solid waste and solar energy it will be analyzed in this thesis, too.

TABLE 20: RES ACCORDING TO EU CLASSIFICATION

	ELECTRICITY	HEAT	TRANSPORT FUEL
BIOENERGY	√	√	√
SOLAR	√	√	
GEOTHERMAL	√	√	
WIND	√		
OCEAN	√		
SMALL HYDRO	√		

Source: Directorate for Energy and Transport EC, 2007

5.2. The EU Targets for Renewable Energy

After the EC´s recommendation to accept Montenegro as a candidate country the Republic is now even more challenged to deal with EU objectives of the 2020 energy agenda.

The Montenegrin department of Energy Efficiency and Renewable Energy Sources provided a detailed energy balance with the following calculation of the RES target for the Energy Community (The forecast energy consumption was taken from a 2007 energy strategy report):

TABLE 21: 2020 RENEWABLE ENERGY TARGET CALCULATION WITH OWN ESTIMATION

Total Final Energy Consumption,	ktoe	732.0		***own estimation***
+ Losses,	ktoe	66.6		
+ Own Consumption,	ktoe	20.1		
Gross Final Energy Consumption 2005 (A)	ktoe	818.7		
Hydro Generation	ktoe	159.7		
÷ Hydro Load Factor 2005		32.2%		
X Average Hydro Load Factor 1992-2005		28.2%		
Normalized Hydro Generation (**B**)	ktoe	140.0		
Other Renewable Energy Sources **(C)**	ktoe	48.2		***58,07***
Total Normalized Renewables	ktoe	188.1	(**D) = (B) + (C)**	***198,07***
Renewable Energy Share 2005		**23.0%**	**(E) = (D) / (A)**	***24,19%***
Flat Rate Increase (F)		**5.5%**		
GDP per Capita 2005, €/head		2,985		
÷ EU-27 Average GDP per Capita, €/head		22,400		
GDP per Capita Index		*13.3%*		
x Residual Effort per EU-27 Citizen, toe/head		0.16		
Residual Effort per Citizen, toe/head		0.021		
x Population 2005, m		0.61		
Residual Effort **(G)**	ktoe	13.0		
Total Primary Energy Supply 2020, PJ		68.62		
converted to ktoe		1,639.0		
x Ratio of GFEC to TPES (assumed constant as 2005)		*81.5%*		
Forecast 2020 Gross Final Energy Consumption **(H)**	ktoe	1,336.4		
Residual Effort 2020 Share		**1.0%**	**(I) = (G) / (H)**	
Total 2020 Renewable Energy Target		**29.5%**	**(E) + (F) + (I)**	***30,69%***

Source: Energy Community 2010: Annual report on the implementation of the acquis under the treaty establishing the Energy Community

When applying to this calculation instead of 48.2 ktoe at the position "*Other Renewable Energy Sources (C)"* my own calculation, namely the amount of 58,07 ktoe which was calculated from 675,25 GWh RES energy production

(Chapter 3.2.1., without hydro power), then the calculation would result into: *Renewable Energy Share 2005 of 24,19%.*

The total 2020 renewable energy target would then result into: 30,69%

In a presentation in Vienna in March 2010 at the occasion of the Energy Community conference Montenegro presented its targets as follows:

EU National target according to Directive 2009/28/EC ~ 30 % RES target, including heating/cooling energy and biofuels (Kovacevic, I. 2010).

The presentation shows a case without the KAP scenario and in particular when discussing energy efficiency issues and energy prices the target of the Montenegrin Government is always presented as a “without KAP” case (Kovacevic, I. 2010). KAP is a political decision and as long as on this subject nothing is finally decided, policies and strategies will not be adjusted and a concrete target for 2020 cannot be determined.

Another influencing factor on the calculation of targets is the methodology used and the problems with the input data, mostly for biomass. It has to be noted that data on consumption and availability of biomass is one of the greatest uncertainties as concluded in a recent study done by IEA. IEA identified that the real use of biomass for heating is significantly higher than the official statistics shows, which impacts not only the calculation of the RES share in the base year 2005 but also the available potential to meet the 2020 targets.

The methodology used to calculate the 2020 RES targets has been based on the principle of equivalent ambition of the Contracting Parties as of EU-member states. A flat rate increase of 5.5% plus a variable share based on the GDP per capita is applied. It is planned to conduct a new study and the outcomes of the study will serve as a basis for the Energy Community in order to decide and determine about the 2020 RES targets. In this comment it is also stated, that UNMIK and Montenegro would need some more time to double check the figures for the target calculations (Energy Community 2010: Minutes and Conclusions of the 2nd Renewable Energy Task Force meeting 24 February 2010 Vienna, Energy Community Secretariat).

On 21 June 2010 the Energy Community Secretariat released the final report of the *“Study on the Implementation of the New EU Renewable Energy Directive in the Energy Community”.* The aim of this study was to assess and analyze the preconditions for the development of renewable energy sources under the assumption that the new EU RES Directive was adopted. The results of the study recommend the following: *"The overall [proposed] target for these seven Parties is higher than the EU's 20% primarily because of their much higher share of renewable energy in 2005 (17% against 8.5%), partially offset by a much lower residual effort on the basis of lower GDP per capita (1.3 % versus 6 % for the EU). Wood is an extensively used source of heating fuel throughout the Energy Community and the "biomass consumption in 2005" is therefore a critical element of the renewable energy target calculation. The availability of data, the inconsistency of data collection and measurement methods across the region pose a serious problem to establish a reliable starting point on which the targets need to be based. I regret to note that due to the uncertainty of the statistical data for 2005, a proposal to the Energy Community Ministerial Council to adopt the new RES Directive in 2010 is not expected",* stated Director Slavtcho Neykov. He added, *„The Energy Community needs realism when approaching the issue of RES. If the 2005 baseline calculation is too high, then we might set a too ambitious 2020 RES target. If the 2005 baseline calculations are too low, then the principle of equal commitment will not hold. The Secretariat considers the possibility to tender a survey with an aim to collect better data and subsequently to re-evaluate the methodology for the 2005 baseline calculations"*. Furthermore the study also highlights the vast renewable energy potential for the whole region (Gretu. G., Lesjak, H.,A., 2010).

Albania, UNMIK, Bosnia and Herzegovina and Montenegro all have targets in excess of 30% as a result of their very high current level of renewables (biomass in the case of UNMIK, and mainly hydroelectric generation for the other three countries). Only Serbia has a low target equal to the EU average with 19% and Croatia with 20%. (Energy Community 2010, Annual Report on the Implementation of the acquis under the Treaty establishing the Energy Community).

The implementation of RES and support schemes also requires in the long run rising energy prices and their adaption to European average. As shown above, energy prices are quite low compared to other EU countries and increase of prices is very often also a political issue, which might be difficult to introduce immediately.

Meeting the EU target requires for countries of the Energy Community more costly technologies and achieving targets also means an increase of renewables in the total energy mix. This might become difficult since Parties of the Energy Community have been forecasting continuing annual energy consumption growth of 2-4% until 2020. The achievement of mandatory targets also requires a policy rethinking with the aim of how to source extra RES energy – whether from domestic resources or from joint initiatives. The policy approach and strategies should target new legal and regulatory measures, including revised support schemes. Otherwise it will be difficult to meet the proposed 2020 targets. (Europolitics – The European Affairs Daily 2010).

Several Parties of the Energy Community have provided specific support mechanisms within their laws or policies, respectively strategy documents in order to achieve targets, but some have still lack full implementation to date. Montenegro is still missing setting out its support mechanisms in primary legislation and also the KAP case is still pending and influencing this delay (Energy Community 2010: Annual Report on the Implementation of the acquis under the Treaty establishing the Energy Community).

5.3. Support Scheme for Montenegrin RES in Comparison with Serbian Schemes

In a telephone conversation with Lucija Rakocevic on October 17 2010, who works for the Ministry of Economics in the Department of Energy it was explained, that the support schemes for RES will be officially announced as feed-in-tariffs until the end of 2010 (Tel.: +382 20 482 186, email: lucija.rakocevic@ee-me.org). The support schemes presented further down are to this moment the accurate schemes for RES, but already in October 2011 the same person stated, that revised schemes will be announced until end of 2011.

The rules for a calculation scheme for wind energy by example were published in Official Gazette of Montenegro, nr. 27/10 of 05/12/2010 under point 3: *Calculation of purchase prices of electricity from wind farms is based on: the specific investment costs, I = € 1,400,000 / MW, the equivalent of the annual time of maximum power wind power = 2300 h / year, discount rate, i = 8%, duration of guaranteed prices, T = 12 years, and the specific annual operating and maintenance coasts, CFO = € 35,00 / MW / year.*

The responsible RES person of the Ministry of Economics, Mr. Igor Kovacevic, gave a presentation in 2010 in Vienna organized by the Energy Community. He presented the following future possible FITs for small hydro power plants, wind energy and biomass:

- Guaranteed price for 12 years, applicable for small hydro power plants, wind farms and biomass;
- Inflation rate is included;
- The price for small hydro power plants is depending from the annual production of electricity;

TABLE 22: PROPOSED SUPPORT SCHEMES FOR MONTENEGRO

Type of Generation	FIT € / MWh
Small Hydro Power Plants	
Up to 0,5 GWh	114,41
From 0,5 – 3 GWh	104,02
From 3 – 15 GWh	74,37
Over 15 GWh	38,42
Wind farms	95,99
Biomass	
Wood-processing Industry	123,10
Forestry and Agriculture	137,06

Source: Kovacevic, I. 2010

Competitive feed-in-tariffs are also depending on the investment environment in a country and their duration and stability. When comparing the Serbian support schemes for RES (see below) with the Montenegrin ones, it is shown, that they are quite similar. Serbia has officially introduced them already in November 2009 and offers a broader range of investment opportunities, because energy production from biogas, solar and geothermal is reimbursed, too. Questionable is the duration of 12 years, because in EU member countries longer periods are normal, which might also have an impact on the availability of financing.

Feed-in tariffs per kWh of electricity, generated from renewables or CHP for a period of 12 years are determined for the Serbian market as follows:

- Small hydropower plants – between 7,8 and 9,7 €c;
- Biomass units – between 11,4 and 13,6 €c;
- Biogas – between 12 and 16 €c;
- Gas from waste water treatment plants and landfill gas – 6,7 €c;
- Wind farms – 9,5 €c;
- Solar power plants – 23 €c;
- Geothermal power plants – 7,5 €c;
- Cogeneration power plants – between 7,6 and 10,4 €c;
- Waste power plants – between 8,5 and 9,2 €c; (Energetika.net, 2009)

5.4. Technologies

Since most of the future investments will be realized through foreign partners and investors with experience in different RES fields, the beneficial effect of implementing modern technology and knowhow transfer will also take place. Further important constrains of RES expansion in Montenegro are high investment costs due to the necessity to import most of the power plant components or other RES components. Montenegro does not have own production facilities like Croatia and there are no plans to set up local production units. Import duties represent an additional cost factor and also the administrative barriers when dealing with import authorities should not be underestimated. It would be advisable to lower or cease import taxes by the Government in order to attract more investments into this field. Lower labor costs will not fully compensate this disadvantage, because most of the RES experts are originating from abroad. It would be also advisable to install training facilities for technology based know-how transfer to local experts.

However, the modernization of the existing infrastructure is another important future challenge and the privatization of EPCG and the underwater cable installment also comprehends the fulfillment to renew the existing old infrastructure (REEEP 2010).

5.5. Aspects and Barriers of Investments into Renewables

A main obstacle to RES developments is determined by time delays related to licensing and planning procedures. Licensing processes are complex and costly and too many involved authorities add to further delays. Also the lack of full implementation of regulatory measures makes effective realization of RES deployments difficult (Energy Community, 2010, Annual Report on the Implementation of the acquis under the Treaty establishing the Energy Community).

A recent paper, presented at the GTZ Regional Energy Efficiency Conference in Budva in May 2010 about several planned small hydro power plants carried the title: “Lessons learned in the realization of UNDP-GEF Medium-Size Project”. One main lesson learned refers to efforts which have to be made in order to facilitate faster planning and licensing procedures and attract investors (Stojic Z., 2010).

Montenegro is progressing with the unbundling of state-owned utilities and the liberalization of its energy market. Grid access and purchasing regulations for RES need to be further developed, because they play a major role in the development of RES with participation of foreign capital. (Energy Community, 2010; Annual Report on the Implementation of the acquis under the Treaty establishing the Energy Community).

One of the main obstacles for introduction of proper support mechanism from the Government is the lack of sound and valid analysis of potentials on renewable resources in agriculture and available technologies. Also the lagging elaboration of legal documents and regulations related to this issue represents a main obstacle. The lack of qualified experts at the side of the Montenegrin authorities is another main problem, which was also observed in other countries of the Western Balkans. (Markovic., M. 2009)

In the field of energy efficiency main barriers for implementation are identified as follows:

- Relatively low energy prices
- Cross-subsidies
- Lack of individual meters (esp. for heat consumption)
- High level of non-payment
- High initial investment costs of EE projects
- Lack of information and awareness on the demand side
- General lack of financial incentives

(Gerner F., 2010)

Barriers are also defined by the business environment and the Global Competitiveness Report of the World Economic Forum. Not only the old not modernized infrastructure is in the focus of criticism, but also the existing business barriers based on slow administrational processes and high level of corruption. (World Economic Forum 2010).

The Doing Business Report about Montenegro, published by World Bank, shows that in 2011 Montenegro dropped its position from 42 to 60, because the country has failed to enhance the competitiveness of its economy in a period of economic and financial crisis. According to the survey, the biggest problem for doing business in Montenegro is the inaccessibility to financing, followed by high taxes, restrictive labor market regulations, inadequate infrastructure, slow bureaucracy and poor work ethic of the working age population as well as unskilled labor (Remikovic, D., 2011).

A main issue for Montenegro, namely eliminating administrative barriers and fighting corruption, is also elaborated in several European Commission Progress Reports. A secure business environment simply attracts foreign investment and a small country like Montenegro heavily depends on foreign capital inflow, investments and the creation of new jobs (Commission of the European Communities, 2009). The European Commission also highlights in all reports organized crime and corruption, in particular at highest levels of the Montenegrin Government.

In the Transparency International Annual Report 2010, which evaluates corruption in 178 countries worldwide, Montenegro is listed at position 69 (Transparency International, 2010).

Another important issue is in general the availability of accurate statistics in all RES related fields, which is currently not the case in Montenegro. Statistics in the field of energy are not reliable even though financial aid from international organizations was provided and international experts were involved in the process of completion. It can be observed, that studies conducted by international organizations on RES are often lacking of profound information and data due to missing reliable statistics and estimations based on wrong values. Some of these studies are presented in this Master Thesis, where the same RES is analyzed differently by different international contracting partners.

An important constraint and barrier of RES expansion are high investment costs due to the necessity to import most of the power plant components (REEEP, 2010).

6. Assessment of Montenegrin RES Potentials and Projects

The largest potential can be identified in hydro power energy generation with approximately 11 TWh/year whereas current utilization level accounts for 17%. The potential for electricity generation from small HPP is approximately 400 GWh, at which potential sites are characterized by relatively small flows and high slopes, which would require specialized technology.

The wind energy potential is relatively low, but certain areas offer wind speeds of 5-6 m/s. Only along the Adriatic coast close to Ulcinj and in mountain ranges close to Niksic average wind speeds of 6-7 m/s were measured, which would provide a capacity of 60 MW for wind energy generation.

Biomass has not been adopted yet as a power source, but is intensively used for heating purposes in private homes. However, the resource potential in Montenegro is promising, with 37% of the country being forested. The private use of biomass became an important issue among members of the Energy Community for future correct evaluation of the 2020 energy and climate target (REEEP, 2010).

Biomass and crop potential is projected between 850.000 m3/year and 1.060.000 m3/year, furthermore wooden waste is evaluated with a potential of 57.000m3/year. Also municipal waste, a still unexplored energy source in Montenegro, is estimated with an amount of 200.000 to 250.000 tons/year as considerably well (Nikolic, D., 2009).

Biofuel is not yet analyzed and is currently not part of the country´s renewable energy strategy. However, it will be evaluated in chapter 6.6. by applying the potential of the Serbian case, which can provide more profound data for calculating the Montenegrin potential.

Based on studies which are supporting the National Energy Strategy, Montenegro has one of the highest potentials for solar energy in South Eastern Europe, with direct solar irradiation accounting for 17-18% of annual time. The solar energy potential with 2.000-2.500 solar hours/year is very promising.

The only study dealing with the geothermal potential of Montenegro was undertaken in the territory of the capital, Podgorica. Underground water of 12-13 degrees Celsius was found, which could be used for summer cooling.

In the following statistic the technical potential was analyzed by applying several studies and own estimations. The technical potential can be defined as: *If technical boundary conditions (i.e. efficiencies of conversion technologies, overall technical limitations as e.g. the available land area to install wind turbines as well as the availability of raw materials) are considered the technical potential can be derived. For most resources the technical potential must be considered in a dynamic context – e.g. with increased R&D conversion technologies might be improved and, hence, the technical potential would increase.* (Resch, G. et. al. 2011)

Data source is indicated below this table:

TABLE 23: POTENTIAL OF RES IN MONTENEGRO

	Technical Potential
Large HPP	9,846 GWh*
Small HPP	1,000 GWh*
Wind Onshore	265 GWh**
Biomass	1,456 GWh***
Waste	78 GWh ****
Solar Heating	5 GWh *****
Solar Electricity	7,650 GWh******
TOTAL POTENTIAL	**20,300 GWh**

Source:
* Energy Community 2010: Chapter 6.1.2.
** CETMA 2007: chapter 6.2.2.
*** Nikolic,D., 2009, Weinreich, A., 2010: Chapter 6.3.2.1.
**** Hellenic Aid and USAID, 2010 and own estimation:
Waste potential was calculated according to waste data retrieved from MSW theoretical potential and inbound tourism data. This result was multiplied with 30% to achieve technical potential according to data from this study. Chapter 6.4.1.
*****Black & Veatch, 2009: 17-18% of annual sun time can be used for the production of energy, Chapter 6.5.2.
******Kovacevic, I., 2010, own estimation: Chapter 6.5.2.

A lack of statistics and proved data further triggers the reliability of these calculations.

If we apply data from the energy balance it shows, that the total consumption of primary energy in 2006 was 46.11 PJ (100%) or 12.808,33 GWh. That means that the current RES potential, which is not yet fully explored, could cover more than 100% of the amount of total energy consumption in 2006.

Parties of the Energy Community have been forecasting continuing annual energy consumption growth of 2-4% until 2020. (Europolitics – The European Affairs Daily, 2010). In 2020 the total primary energy supply is estimated to reach PJ 68.62 or 19.061 GWh for Montenegro. The technical potential of today would also cover 100% of this estimated amount of primary energy supply. Under the estimation of more advanced technology, better forest management, an improved grid network, etc., there should be no doubt that Montenegro will be able to achieve even a very high energy and climate target

The energy sector in Montenegro is characterized by high-energy intensity in comparison with EU and other developed countries, which is primarily caused by the high consumption level in all consumption sectors. Therefore the RES potential together with energy efficiency provisions, which would generate energy savings up to 20%-30%, commonly offer a promising opportunity to be developed and invested in (Pavlovic, B. 2010).

The Montenegrin potential is elaborated in the Governmental Country´s Action Plan for the period 2008 - 2012, which determines the following:

CC 1: Increase energy efficiency and use of renewable energy sources in consumption and under point

CC 5: Development and exploitation of renewable energy sources (Canovic M. 2009)

The strategy paper further explains the development and exploitation of renewable energy sources with a main focus on the following RES:

- Project of building small HPPs
- Project of using wind energy for electricity generation
- Project of using biomass for heat and electricity cogeneration
- Project of using municipal waste for heat and electricity cogeneration: possible biomass exploitation in Berane and Nikšić

- Project of building HPP Komarnica
- Project of building 4 HPP on the Morača river

The renewable energy resource potential is a key constraint in the determination of meeting the 2020 RES targets.

A recent study done by USAID and Hellenic Aid in 2010 evaluated for Montenegro the following potential **(**Energy Community, 2010, Study on the Implementation of the New EU Renewable Directive in the Energy Community):

TABLE 24: MONTENEGRO´S RENEWABLE ENERGY POTENTIAL ACCORDING TO HELLENIC AID STUDY

	BIOMASS TWh/year	**HYDRO Electricity GW**	**WIND Onshore**	**SOLAR Thermal**
MONTENEGRO	*4,2 TWh*	*2,0 GW*	*400 MW*	*33 MW*

Source: Hellenic Aid and USAID, 2010

The study was done in 2008 with following plans for RES capacity until 2025:

Small hydropower plants 80MW capacity, wind energy 60 MW total installed capacity, energy from waste 10 MW installed capacity. The use of biogas, biomass and photovoltaic is not evaluated yet and solar energy has so far been limited to warm water use only. The use of biofuels is expected to be implemented after 2011 and could reach 0.68 PJ in 2025. As of today it is already known, that none of the tendered small HPPs started becoming operational in 2010 and there are reasonable doubts that interim aims will be achieved (Energy Community 2010, Study on the Implementation of the New EU Renewable Directive in the Energy Community).

One of the key elements for the 2020 targets will be whether there is economic benefit for an EU member state to import renewable energy from a Party of the Energy Community, like Montenegro. A main focus will be put on joint programs and investment opportunities. Montenegro will have to compete with other members of the Energy Community and third countries outside the Energy Community and the EU.

The competitive position of Montenegro will depend on the marginal cost of its energy production compared with other options and determinants like capital costs, financing costs and labor costs. The capital cost of a wind turbine built in Montenegro will be the same as for a wind turbine in Germany, because the turbine market is Europe-wide. Any savings in labor costs in Montenegro are likely to be off-set by the potential higher cost of capital because of the less developed, higher risk renewable energy environments (compared with Western Europe). Experts have to be hired from abroad for even higher costs. Also the additional cost for modernizing the grid access and the grid network itself is in many cases underestimated.

Montenegro as a Party of the Energy Community will have to compete with third countries where also renewable energy is produced for EU member countries. These countries have the advantage that they will not have to meet their own renewable energy targets first, and hence are likely to have lower marginal cost than countries of the Energy Community. Consequently and in order to be competitive it is necessary that Energy Community members develop more robust legal and regulatory frameworks, operational conditions and administrative arrangements. (Energy Community 2010, Study on the Implementation of the New EU Renewable Directive in the Energy Community).

In the following section RES in Montenegro for small hydro power plants, biomass and wind energy will be evaluated as an investment opportunity. A focus will be put on installed capacity and status quo analysis, potential and prospects as well as long run generation costs. Also the potential for biofuel, municipality solid waste and solar energy will be analyzed.

6.1. Hydro Power Assessment

6.1.1. Installed Capacity of HPPs and Status Quo Analysis

Total energy production capacity in 2005 was 868MW of which 658MW (76%) were coming from hydropower plants (Energy Community, 2010: Study on the Implementation of the New EU Renewable Directive in the Energy Community).

A majority share namely 360 MW are generated in the Piva power plant. Piva was completed in 1976 and is one of the most modern hydro power plants in Montenegro. The remaining ones were installed in the 1950's and 1960's (Black & Veatch B&V, 2009).

The production of electricity varies considerably and is depending on rainfall. Thus, in 2007 total production of electricity from hydropower plants was only 1.278,3 GWh due to low precipitation, while total production of electricity was 2.044,7 GWh which could only meet 44% of the Montenegrin final electricity consumption (Energy Community, 2010, Study on the Implementation of the New EU Renewable Directive in the Energy Community).

Table 25 shows the age structure of existing small hydro power plants in Montenegro. Most facilities are more than 40 years in operation. In the last ten years there was no adjustment or revitalization of existing plants undertaken. In addition, Montenegro has no own industry for producing electrical and mechanical equipment for these plants. All small hydro power plants are owned by the national electricity company EPCG, which is now partly privatized.

TABLE 25: AGE STRUCTURE OF EXISTING SMALL HPPS

AGE	**0-9**	**20-30**	**40-50**	**> 60**	**Total**
Number of sHPPs	*2*	*1*	*3*	*1*	*7*
Share in % of sHPPs	*29*	*14*	*43*	*14*	*100*

Source: Ministry of Economy , 2006

According to the EPCG AD Niksic, only 17 % of the total hydroelectric potential of Montenegro is used (HPP Perucica - 307 MW, 970 GWh power generation; HPP Piva- 342 MW, 870 GWh; sHPP - 8.92 MW, 21 GWh). Locations of small hydro power plants are characterized by relatively low flows and high falls. According to these data small hydro power plants were operating on average 2.354 hours a year, which determines a capacity factor of 27% (Ministry of Economy, 2006).

The ultimate impact of small hydro power plants on the generation of electricity is small. In the future Montenegro will probably be forced to build greater plants, caused by a continuous increase of electricity consumption and increase of imports.

6.1.2. Hydropower Potential

Hydro power is one of the most valuable natural resources of Montenegro. The country has a technical potential for hydropower with approximately 9.846GWh annually for large and 1.000GWh for small water flows. Montenegro has about 1.490 MW of planned hydroelectric capacity. Much of the capacity is planned to be operational until 2013 (Black & Veatch B&V, 2009).

Miodrag Canovic from the Ministry of Economic Development presented at the GTZ sponsored Energy Efficiency Conference in Budva in March 2009 the following projects for hydro power energy generation:

- Project for revitalization of small HPPs
- Project for revitalization of HPP Piva
- Project for revitalization of HPP Perućica – phase II

This realization would generate an additional 300 GWh per year.

The following new plant developments were introduced:

- Project of building small HPPs: Government awarded concessions for 8 water flows for exploration and construction of small HPPs, contracts were signed on September 26th, 2008 preparation of a new tender for construction of small HPP is underway;
- Project of building HPP Komarnica, capacity 168 MW and average annual generation of 231,8 GWh;
- Project of building HPP on the Morača river: Four hydro power plants: Andrijevo, Raslovići, Milunovići and Zlatica with total capacity of 238 MW and annual generation of 693 GWh;

In the Development Strategy for Small Hydropower Plants hydropower altogether (small and large scale HPP) represents a significant share of electricity production of 60 – 75 %, however currently only 17 % of its potential is used. The share of small hydropower plants in electricity production was 1.1 % in 2005 and could rise to 3 – 5 % by 2015.

As already mentioned the interim aims for 2010 were not achieved, because none of the tendered small hydro power plants was actually installed (Energy Community, 2010, Study on the Implementation of the New EU Renewable Directive in the Energy Community).

Already the construction of several small hydro power plants was delayed, even though concessions were already tendered and provided in 2008. It is not realistic to expect that all identified sites will be developed due to various reasons like: environmental protection movement for National Parks, economic impacts, difficulties in obtaining permits, lacking grid connection and other influencing factors (Canovic M., 2009).

The problem mostly appears due to the weak cooperation of different policy makers involved in RES related issues. Also intensive public debates about RES would result in a more positive attitude towards the use of RES and higher awareness of the Montenegrin Authorities and population (Markovic., M. 2009).

In October 2010 the Montenegrin Ministry of Economy completed a draft act for the Morača hydropower plant concession, which will be tendered after public discussions. The country's tender commission awarded four participants out of five for the pre-qualification procedure:

- Sinohydro Corporation Limited, China;
- Enel SpA, Italy;
- A consortium led by the Italian A2A SpA; and
- Strabag International GmbH, Austria.

In September 2010, the Minister of Economy, Branko Vujović signed a concession agreement for the construction of small HPPs on the Tušina and Komarača rivers with Montenegrin Kroling company from Danilovgrad. The project includes the construction of five sHPPs, one on the Tušina with an installed capacity of 4 MW, and four sHPPs on the Komarača with total installed capacity of 6 MW. The concession was granted for 30 years for Tušina, and 25 years for Komarača and the investment amount will be 18.8 million €. Also for the consortium Hydro CG, a concession was granted for the construction of two small hydropower plants on the Vrbnica river with total installed power of 12 MW for a period of 25 years with a planned investment of 19.7 million €.

In the same months two other concession agreements were signed with the consortium Elektrotehna-Radius for construction of sHPP plants on the Murinska and Trepačka rivers. Both concessions were granted for a period of 30 years and the installed capacity will be 2.4 MW on the Murinska river and 8.3 MW on the Trepačka river. The value of the investment will reach 13.3 million € (Zumbar, A., 2010).

6.1.3. Hydro Power Energy Prospects and Framework

6.1.3.1. Investment Costs

In the following section the generation costs of electricity for small hydro power plants will be analyzed in accordance with data of reference projects in the region:

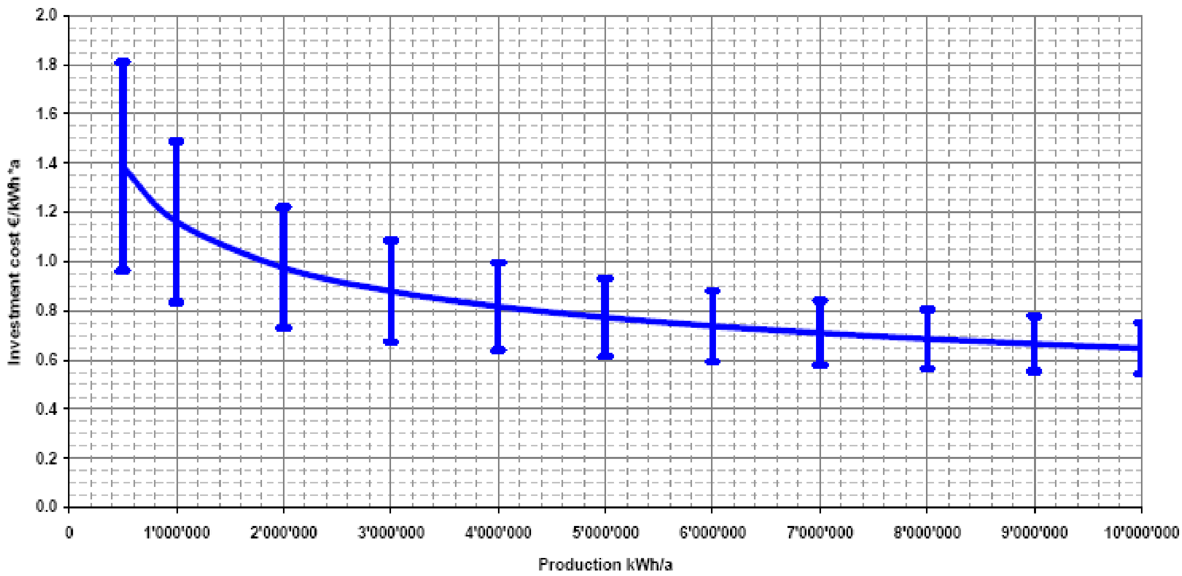


FIGURE 9: INVESTMENT COSTS RELATED TO ANNUAL PRODUCTION (€/KWH)
Source: Fras D. 2009

At the occasions of the Energy Efficiency Conference in 2009 Mr. Danilo Fras presented the above table of investment costs per kWh. Small hydro power plants are calculated with full load hours of 2.354 per year, respectively a capacity factor of 27% (Ministry of Economy, 2006). According to figures of Ecofys investment costs for small scale HPP are in the range between € 975 – 6.050/ kWel. However, Mr. Fras` calculation only suggests investment costs with a maximum of € 1.800 /kWel, which might express a too optimistic approach (Ecofys, 2011). In chapter 6.1.3.3. are discussed the LRGC under different scenarios and periods applying a rather worst case scenario calculation.

Besides the availability of quality water management data, hydrological geometric measurement data (including cadastral maps with list of owners, access road availability), also information about grid connection, distance and voltage level, cost-structure of national and international suppliers are necessary. Furthermore a minimum equity of 20% of total investment together with a long term financing of minimum 10 years duration are required for the development of SHPP in this region (Fras D., 2009).

6.1.3.2. Authorities involved in the Planning Process of SHPP

The key parties participating this process are the Government of Montenegro, the Ministry of Economy, the Ministry of Agriculture, Forestry and Water, the Energy Regulatory Agency, the Ministry of Environmental Protection, EPCG AD Niksic (network operator, supplier) and authorized bodies of local governments besides the investor.

The duration of the entire authorization process for the construction of small hydro power plants is estimated to be less than six years (minimum time). This estimation assumes that hydrological data for a specific location are already available.

However, too many authorities are involved and planning processes are in reality too long. Even though the potential is promising, all newly planned SHHPs will be delayed in their realization. There is actually more demand for building large capacity hydro power plants which might be triggered by a recently started green movement for the protection of National Parks.

6.1.3.3. Long Run Generation Costs for small scale HPP

The LRGC costs will be applied with different parameters and the result will prove, whether the proposed support schemes under different scenarios are economically or not.

The CRF, Capital Recovery Factor was calculated with an interest rate (z) of 6,5% and 10% due to high risk and for the periods (pt) of 12, 15, 20 and 30 years:

$$CRF = \frac{z^* (1+z)^{pt}}{[(1+z)^{pt} - 1]}$$

TABLE 26: CFR CALCULATION FOR 6,5% AND 10% FOR PERIOD OF 12, 15, 20 AND 30 YEARS

Payback Time YEARS / Interest Rate %	**12 years**	**15 years**	**20 years**	**30 years**
6.5 %	*CFR 0,122*	*CFR 0,106*	*CFR 0,091*	*CFR 0,077*
10 %	CFR 0,147	*CFR 0,131*	*CFR 0,117*	*CFR 0,106*

For the calculation of the LRGC the following parameters were applied:

$$LRGC = \left[(C_{fuel}) + \frac{C_{O\&M}}{H} * 1000\right] + \frac{1000*I*CRF}{H}$$

Operation and Maintenance Costs per Energy Unit ($C_{O\&M}$): 40 €/kW_{el}/year (Ecofys, 2011)

Full Load Hours per Year (H): According to data from the Montenegrin Government small hydro power plants are operating on average 2.354 hours a year, which determines a load factor of 27% (Ministry of Economy, 2006).

Investment Costs per kW €/kW_{el} (I): 2.000 and 4.000 €/kW_{el} (Ecofys, 2011)

Capital Recovery Factor (CRF): with interest rate of 6,5% and 10% for periods of 12 and 20 years. The 12 year duration are reflecting the proposed period for FITs.

Feed-in-Tariff:
Up to 0,5 GWh………. 114,41 €/MWh
From 0,5 – 3 GWh….. 104,02 €/MWh
From 3 – 15 GWh…… 74,37 €/MWh
Over 15 GWh……….. 38,42 €/MWh

TABLE 27: LRGC FOR CRF OF 6,5% AND 10% AND INVESTMENT COSTS OF 2.000 AND 4.000 €/KWEL

Investment costs / CRF	2.000 €/kWel	4.000 €/kWel
12 Years/ 6,5%	*120,64 €/MWh*	*224,30 €/MWh*
12 Years/ 10 %	*141,88 €/MWh*	*266,78 €/MWh*
20 Years/ 6,5%	*94,30 €/MWh*	*171,62 €/MWh*
20 Years/ 10%	*116,40 €/MWh*	*215,80 €/MWh*

When comparing the calculated LRGC with the proposed FITs of the Montenegrin Government for small scale units up to 0,5 GWh with load factor of 27% and 0,212 MW installed capacity a **€ 114,41/MWh** remuneration would be paid. For installed capacity from 0,212 to 1,27 MW the remuneration accounts for **€ 104,02 /MWh** and from 1,27 to 6,37 MW by given load factor the FITs would be € 74,37 MWh. LRGC would only be economically if investment costs stay in the range of € 2.000 /kWel and when CFR for 20 years with 6,5% and 10% interest rate is applied with a maximum installed capacity of 1,27 MW. According to figures of Ecofys investment costs for small scale HPP are in the range between € 975 – 6.050/ kWel, what means, that investment costs over € 2.000 /kWel when applying these proposed schemes would be neither economically nor sustainable (Ecofys, 2011).

6.2. Wind Energy Assessment

6.2.1. Wind Park Projects and Status Quo Analysis

Miodrag Canovic from the Ministry of Economic Development presented at the GTZ sponsored Energy Efficiency Conference in Budva in March 2009 the following information about wind energy projects:

“Project of using wind energy for electricity generation are of importance and detailed measurements on potential locations is underway as well preparation of legislation and tender documentation” (Canovic, M., 2009).

2 licenses for wind parks in Krnovo and Mozura with an installed capacity of 96 MW are already contracted, but these wind parks are not yet constructed and are further delayed due to lack of finally approved support schemes and administrative barriers (Energy Community, 2010, Day of Montenegro in the Energy Community).

6.2.2. Wind Park Potential

The technical potential on the most attractive locations in Montenegro is estimated up to a maximum capacity of 100 MW, but more measurements have to be undertaken. The Montenegrin strategy currently foresees a minimum of 60 MW of installed capacity: two wind-farms of total capacity of 10 MW (2x5 MW) expected to be operational in 2011 (already delayed), 3 wind farms of total capacity of 30 MW (10 MW each) shall be operational within the period 2015 to 2020 and another 4 wind farms with total capacity of 20 MW should be installed until 2025. The investments until 2025 will range at the amount of 160 million EUR (Institut za Istrazivanja u Energetic, 2007).

The main wind Bora is not blowing continuously, which does not offer too favorable conditions for wind park developments. Furthermore, installments of wind turbines directly along the Adriatic coast are not favored by the Government due to its high attractions for investments into tourism projects. However, the coastal zone would offer a better potential for off-shore wind parks, than onshore installments. Also the integration of wind parks into the relative small power system of Montenegro demands some advanced technical solutions which could make these projects too costly.

The climate is warm enough and iced blades shall not become a significant problem for wind parks within the measured areas. The Italian Ministry for the Environment, Land and Sea and Renewable Energy Resources has made comprehensive wind measurements on Montenegrin territory (CETMA, 2007).

The following results, illustrated by a study done in 2007 by CETMA, show average speed of wind and average theoretical potential of wind at a reference altitude of 50 m above sea level. The analysis shows significant potential of wind energy at certain parts of the country, which could supply even 20-25% of total annual energy consumption.

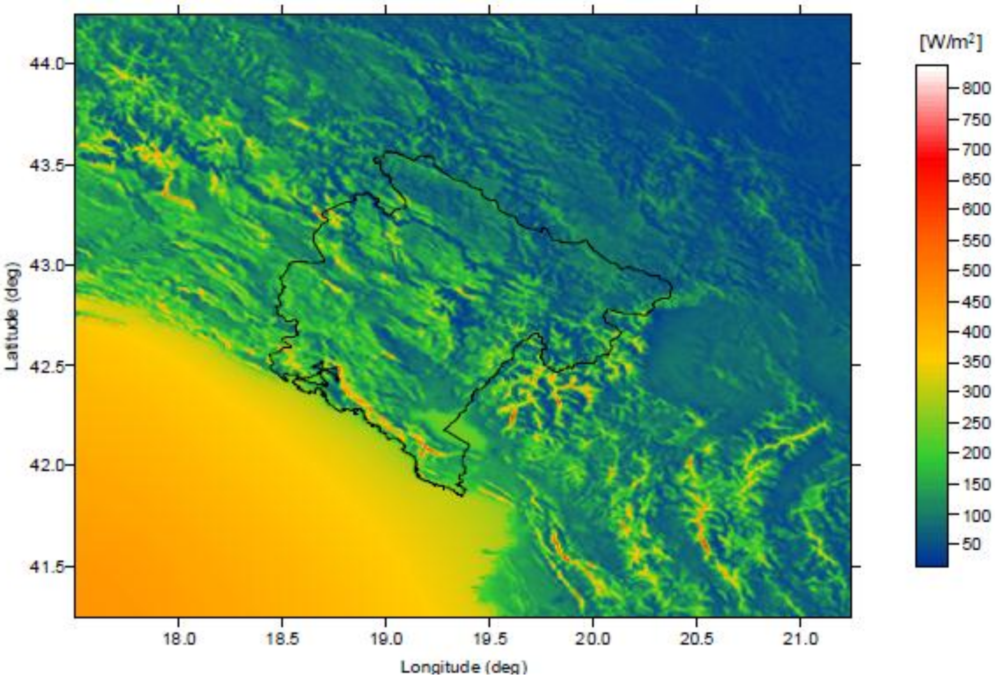


FIGURE 10: AVERAGE WIND SPEED [M/S] AT 50M ABOVE SEA LEVEL
Source: CETMA, 2007

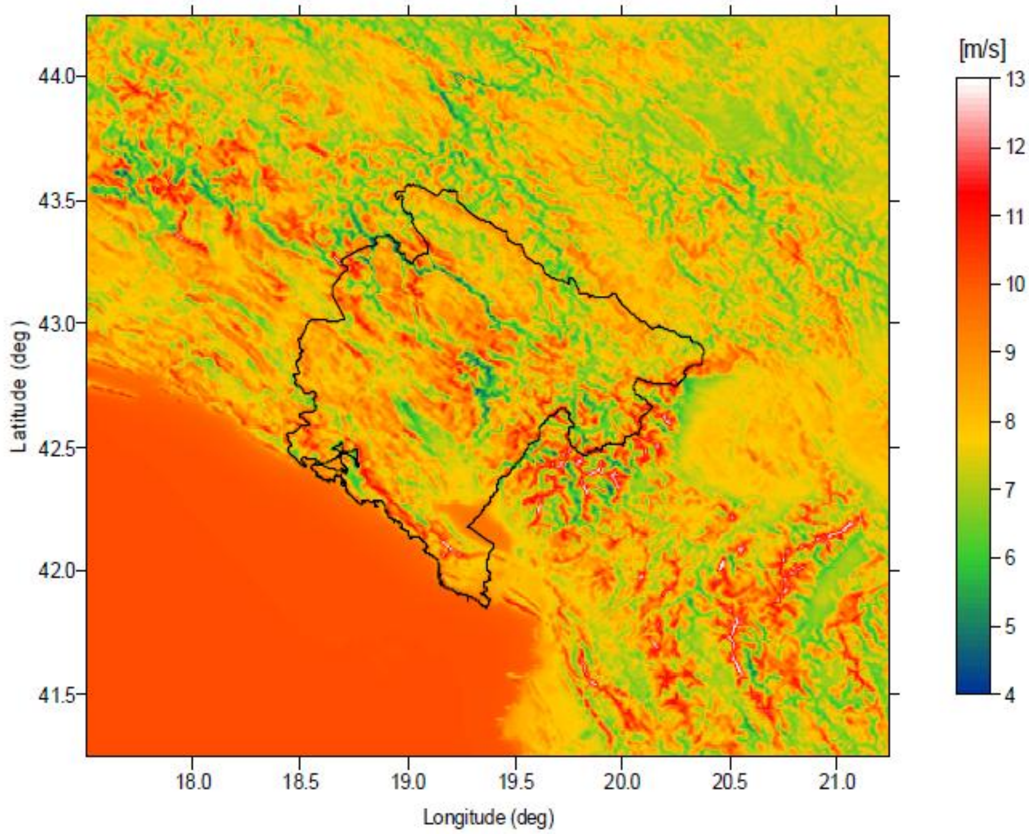


FIGURE 11: REAL POTENTIAL OF WIND [M/S] AT 50 M ABOVE SEA LEVEL
(with real constraints due to the high mountains and deep river canyons)
Source: CETMA, 2007

The following locations were identified as the most attractive ones:

Coastal areas – this area offers the most important wind resources of the country, as at the hills of Rumlja with highest wind speed and not directly located at the sea shore. Another very interesting area can be found on the hills surrounding Petrovac, crossed by a main road and two 220 KV electric lines. Average wind speed in these regions is more than 6 m/s.

Hills around Niksic – the average wind speed is in the range between 5.5-6.5 m/s. The existing road network and grid connection turn this area into one of the most attractive locations for future wind energy generation. This second location does not offer touristic potentials either and is therefore very eligible for wind park investments (CETMA, 2007).

Montenegro offers a feasible potential for wind energy projects in certain areas of the country, but coastal areas are excluded from wind park developments. Furthermore the wind speed analysis shows that most of the windiest areas are located at the ridges of mountains. These locations require high infrastructure investments in order to gain grid access for connection. For these locations small turbines in the range of 750 - 1000 kW would be recommended, but further detailed wind measurements would be necessary. Around the hills of Velji Garac (next to Danilovgrad) and along the Njegos ridge (west of Niksic) wind speeds are above 7 m/s and are covering a length of approximately 80 km. Assuming that about 25% of the overall extent can be used for the installation of wind turbines on an area of 20 km length, 5 turbines of 1 MW could be installed per km with an output of 5 MW/km. This amount sums up to an overall potential for wind power generation of 5*20km = 100 MW. An assumed capacity factor of 30% at this location would generate power of 30 MW or 265 GWh/year. This energy output would cover approximately 6-7% of total yearly power consumption of Montenegro (CETMA, 2007).

The Montenegrin Government has to intensify the preparation of additional studies regarding the evaluation of this wind energy potential and these studies should focus on micro locations, too. Any investment strategy should therefore carefully analyze the incomplete infrastructure. Lacking grid access and availability could even impede an investment, when grid connection is only possible for very high additional investment costs. Also green movements should be seen as a future obstacle as observed recently for the lobbying of creation of more National Parks. The above mentioned and measured locations are closely located to the national grid system, but would require modernization of the electric power lines.

The current potential of wind energy generation is estimated to be at least 60 MW, which might not be large enough for strategic investors when considering administrative barriers, complicated permission processes and difficult grid access with out-of-date network facilities.

6.2.2.1. Wind Measurements

The measurements took place in the following locations at multiple sites:

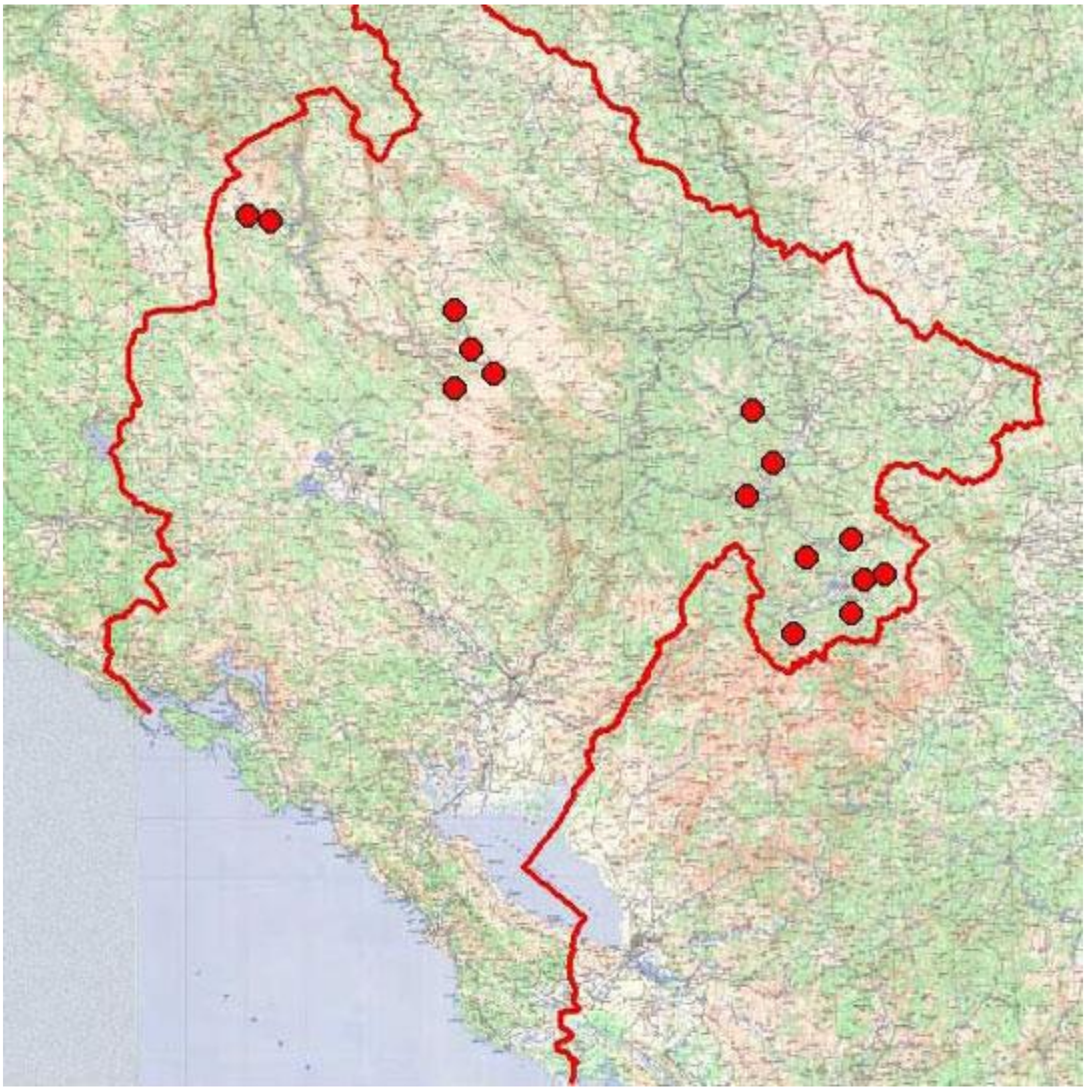


FIGURE 12: LOCATIONS OF WIND MEASUREMENTS IN MONTENEGRO
Source: Ministry of Economy department of energy, 2010: oie-cg.me http://www.oie-cg.me/srp/Izvori_Vjetar_Mjerenja.asp

The most attractive locations for potential wind parks in Montenegro are located at Možur hill and Krnovo hill, both close to Niksic in Central Montenegro. The results for these measurements can be retrieved at the following websites:

Month/ Year Locat.	Sep 08	Okt 08	Nov 08	Dec. 08	Jan 09	Feb 09	Mar 09	Apr 09	May 09	Jun 09
Gvozd	6,22	5,29	5,58	8,11	6,66	9,09	8,66	5,01	5,61	5,24
Bukovic	6,01	4,77	5,22	6,93	5.12	8.46	7.53	4.44	4.99	4.18
Konjsko	4,92	3,96	4,51	6,89	4.68	6.75	6.55	3.89	4.48	-

Month/ Year Locat.	Jul 09	Aug 09	Sep 09	Average
Gvozd	5,34	6,07	7,74	**6,24**
Bukovic	4,33	5,15	7,52	**6.47**
Konjsko	-	-	-	**5.66**

FIGURE 13: WIND MEASUREMENT RESULTS FOR KRNOVO
Source: Ministry of Economy department of energy, 2010: oie-cg.me
http://www.oie-cg.me/doc/Izvjestaj%20o%20mjerenjima%20-%20Krnovo.pdf

In the following figure are shown wind measurements for Mozura:

Izjestaj mjerenja za period 22.05.2008-22.05.2009

Pozicija meteoroloskog tornja u UTM WGS 84 sistemu :
istok 354.524
sjever : 4.647. 286

Visina mjerenja I brzina vjetra :

Visina	Dobijeni spaseni podaci u %	Snimanja	U* max m/s	U* min m/s
68.0 m	100.0	52488	28.8	5.8
60.0 m	100.0	52488	28.6	5.7
40.0 m	100.0	52488	28.1	5.6

* U – oznacava prostu aritmeticku sredinu

FIGURE 14: WIND MEASUREMENT RESULTS FOR MOZURA
Source: Ministry of Economy department of energy, 2010: oie-cg.me
http://www.oie-cg.me/doc/Izvjestaj%20o%20mjerenjima%20-%20Mozura.pdf

6.2.3. Prospects for Wind Parks in Montenegro

The average investment for a wind turbine is around 1 million € per MW plus costs for installment, which varies depending on the location. Yearly operation and maintenance costs are around 1% of the original investment costs, increasing during the years and the typical lifetime is usually estimated to be around 20 years.

The economic feasibility of the investment mainly depends on two key factors: the energy purchase price over time and the capacity factor and does not significantly change with different wind conditions.

The costs to lease land is subject of a public bidding procedure, with a starting price for the annual lease of 5 c€ /m2. The duration of the lease is up to 20 years (Ministry of Economy Department for Energy, 2010).

The typical size of turbines varies between 500 KW and 5 MW and hub height are in the range between 30 and 160 meters with rotor diameters between 30 and 120 meters. The theoretical limit for extracting mechanical energy from a wind flow is known as Betz Limit and is around 59%. The power production strongly depends on wind speed and continuity and the average yearly power output is related to the mean wind speed. The ratio between the average wind power delivered by a plant installed and the nominal power is called capacity factor. Wind power plants in Europe have capacity factors between 15 and 40%.

Upon information gained from the Montenegrin Ministry of Economy the price for 1 kWh is 0.045 €/KWh without any form of subsidies and 0.09599 €/KWh when subsidized by support schemes inclusive inflation for a period of 12 years.

For wind park projects further in depth analysis regarding wind measurements, grid enlargement and connection, licensing and permission procedures as well as financing and taxation systems (repatriation of profits) should be undertaken.

6.2.4. Long Run Generation Costs for Wind Parks

For the calculation of the LRGC the following parameters were applied:

Operation and Maintenance Costs per Energy Unit ($C_{O\&M}$): 40 €/kW_{el}/year (Ecofys 2011)

Full Load Hours per Year (H): 20% with 1.752 load hours, 26,25% with 2.300 load hours and 30% with 2.628 load hours. The Montenegrin Government discusses a capacity factor of around 30% in their studies.

Investment Costs per kW €/kW$_{el}$ (I): 1.500 €/kWel (Ecofys 2011)

Capital Recovery Factor (CRF): with interest rate of 6,5% and 10% for periods of 12 and 20 years. The 12 year duration are reflecting the proposed period for FIT remuneration.

Proposed FIT for Wind Parks: 95,99 € / MWh

TABLE 28: LRGC FOR DIFFERENT CRF AND INVESTMENT COSTS OF 1.500 €/KWEL AND CAPACITY FACTOR OF 20%, 26,25% AND 30%

Full Load Hours / CRF	Capacity Factor 20% or 1.752 h	Capacity Factor 26,25% or 2.300 h	Capacity Factor 30% or 2.628 h
12 Years/ 6,5%	*127,28 €/MWh*	*96,96 €/MWh*	*84,85 €/MWh*
12 Years/ 10 %	*148,69 €/MWh*	*113,26 €/MWh*	*99,12 €/MWh*
20 Years/ 6,5%	*100,74 €/MWh*	*76,74 €/MWh*	*67,16 €/MWh*
20 Years/ 10%	*123,00 €/MWh*	*94,30 €/MWh*	*82,00 €/MWh*

The calculated LRGCs for these 12 scenarios show that the proposed FIT of 95,99 €/MWh is eligible for 5 calculated LRGC but not for a capacity factor of 20%. It is interesting to observe, that the official published FIT for wind parks in the Montenegrin magazine Gazette in 2010 (chapter 5.3.) are proposing 2.300 full load, which equals a capacity factor of 26,25% but most of the studies done on wind measurements are based on a capacity factor of 30% and more. As a matter of fact it can be concluded that wind park projects under current scheme proposal can be only economical with capacity factor of 26,25% or higher for the duration of 20 years with interest rate of 10 and 6,5% and for the 12 year period with capacity factor of 30% of higher when interest rate of 6,5% is applied.

6.3. Biomass Assessment

A biomass assessment is under the current Montenegrin legislation and provisions not fully accomplishable. This Master Thesis will adopt the status quo of biomass in Montenegro by analyzing available information and studies. There is definitely a need to implement measures which should support solutions for faster and more efficient development of biomass production in general and a market of energy-generating products based on woody biomass. Also the proposed support schemes lack of fine tuning in order to meet the requirements of the local market.

6.3.1. Status Quo of Biomass Use

In a regional study for biomass in 2010 it was concluded that the wider use of biomass for energy currently does not exist in Montenegro and the residual wood from hardwood is traditionally used for heating households and partially also for cooking. Some of the wood-processing industry companies use biomass for the production of energy for self-use. A significant increase on the local market is expected with the introduction of pellets and briquettes, but for that a local market has to be created and technology transfer needs to happen first. Also the fact that wood is taken out illegally from forests has to be fined, otherwise selling expensive pellets or wood briquettes will hardly turn into a business. The need for energy from biomass is increasing and the existing forests offer a huge potential, at which sustainable forest management has to be introduced first. (Nikcevic V, 2010). Furthermore it will take some time to create awareness and to establish functioning markets for biomass products on the supply as well as on the demand side.

In general it can be stated that rural areas have an economic and social decline, but rural economy is in many cases still self-sustaining. The targets for 2020 are greatly influenced by the use of biomass for heating and cooking and statistics do not show the real effect of these habits in particular in the Western Balkans.

A study published in Utilities Policy in 2009 analyzed, that households in Montenegro primarily use electricity and fuel wood for heating during the winter months. According to this study almost two-thirds of households (62%) are using fuel wood for heating. Among the poor the dependency on fuel wood is even higher, with 90% of poor households relying to some extent on fuel wood for heating. The percentage of households using fuel wood is higher in rural areas (86%) and in the northern part of the country (88%), where the availability of fuel wood is greater and the climate is colder (Silva P. et al, 2009). The following table originally retrieved from the Statistical Yearbook of Montenegro (MONSTAT, 2009), shows the consumption of certain fuels for heating of permanently inhabited flats in Montenegro in 2008, where almost 36% use fuel wood for heating:

TABLE 29: DIFFERENT HEATING FUELS OF PERMANENTLY INHABITED FLATS IN MONTENEGRO IN 2008

FUEL TYPE	**Unit**	**Consumed Amounts/ Unit**	**Unit Energy Value in kWh/ Unit**	**Total Amount of Energy in kWh**	**Total residential Space heated in m2**	**In % of total**
Electric Power	*kWh*	*820,365,600*	-	*820,365,600*	*5,127,285*	*44 %*
Coal	*T*	*73,455*	*2,558.611*	*187,942,779*	*1,174,642*	*10 %*
Fuel Oil, Heating Oil	*T*	*7,829*	*9,790*	*76,645,910*	*479,037*	*4,1%*
Fuel Wood	*m3*	*254,944*	*2,629*	*670,247,776*	***4,189,049***	***35.9%***
Flats	*with*	*central*	*Heating*		*692,733*	*6 %*
TOTAL					**11,662,746**	**100 %**

Source: LUX Development, 2010

As a matter of fact woody biomass has its place in the energy balance of Montenegro and it is assumed that a little more than 6% of the total energy consumption is caused by burning wood (Glavonjic B. et. al., 2007).

This influencing factor triggers the target formulation of 2020 for RES (Energy Community, 2010, Secretariat tenders a Study on Biomass Consumption for Energy Purposes in the Energy Community).

“The analysis of Directive 2009128/EC has achieved a priority status in the activities of the Energy Community for 2009 and 2010, consequently a study on the implementation of the Renewable Energy Directive in the Energy Community' ("RES study") has been launched by the ECS in March 2009 with the aim to assess the capacity of the energy sectors of the Contracting Parties. The results of the RES Study has identified problems with the availability of reliable data related to the biomass consumption statistics, consistency of data collection and measurement methods across the region. Unavailability of sound biomass data hindered the institutions of the Energy Community to propose a decision on the adoption of the entire Renewable Energy Directive 2009/28/EC in 2010. Therefore, a clear understanding of the renewable energy consumption in each of the Contracting Parties is a crucial first step in the 2O2O RES target calculation.” (Energy Community, 2010, Study on the Implementation of the New EU Renewables Directive in the Energy Community)

6.3.2. Biomass Potential

The Montenegrin biomass energy potential was presented by Mr. Igor Kovacevic at the occasion of a recent conference of the Energy Community in Vienna in 2010:

TABLE 30: BIOMASS POTENTIAL OF MONTENEGRO

BIOMASS			**ENERGY**	
Sector	**Units**	**Quantity**	**KWh/t**	**Total GWh**
Forestry 25% moisture	T	470.057	3,085	1,450
Wood processing industry 12% moisture	T	298.306	4,000	1,193
Forest cultured plantations 25% moisture	T	455,600	3,000	1,367
Residuals from viticulture 25% moisture	T	31,791	3,000	95
Husk from grape trees 10% moisture	T	15,795	5,500	87
Husk from olive trees 10% moisture	T	1,044	5,500	6
TOTAL	T	1,272,593	3,300	**4,200**

Source: Kovacevic, I., 2010: Renewable Energy Sources in Montenegro, Investing in Energy Efficiency and Renewable Energy

According to this presentation Montenegro´s biomass energy potential of 4.200 GWh is 1.5 times greater than the current electrical energy production (2.800 GWh). The Montenegrin forests (2.817 GWh) and the wood processing industry (1.193 GWh) would produce 4.000 GWh of energy per year, but this figure is probably based on unreal estimations. An analysis done by LUX-development and an estimation undertaken by a German expert show different results, which will be discussed below.

6.3.2.1. Montenegrin Forests and their Potential

A main problem is still the lack of maps that show exact data on forests for accurate evaluation. The situation in the cadastral system is very chaotic and has already become a main EU concern. Currently World Bank and EU are working commonly on a program to implement reliable data and modernize the cadastral system of Montenegro.

Since cadastral maps for agricultural land and land covered with forests as well as standards for their recording have not yet been harmonized, one part of the territory is recorded two times, namely as forest (not overgrown wood) and as agricultural land (meadows) (Ministry of Economic Development, 2007, Spatial Plan of Montenegro Until 2020). This conclusion also shows the dilemma of available information for evaluating the actual existing potential.

Dr. Axel Weinreich, a German expert on forests, analyzed at the GTZ Energy Efficiency Conference in April 2010 the status quo of Montenegrin forests, which would offer a technical potential if realized of approx. 1.2 Million MWh (1.200 GWh) for supplying heating systems (HP) or CHPs:

- 120 MW of heating systems (HP)
- 30 MW of electric power capacity (CHP)

Up to date information from the National Forest Inventory shall be available before end of 2011, when the new maps will be finalized. The current available data are showing the following situation:

State forest: the productive North with 60% of the State forest (~ 262.500 ha);
The South & unmanaged areas of 40% of State forest (~151.000 ha)
Private forest: 40% of the total forest area (~ 240.000 ha)

.

Total: Estimation of 620.000 ha of forest, which accounts for 45% of Montenegrin territory

Total forest of Montenegro is estimated to be 620.000 ha, when deducting the double registration of forest and agricultural land by estimation of experts. This amount offers a maximum potential of 2.3 Million MWh of woody biomass and an actual technical potential of 1.2 Million MWh / year which accounts for 53% of maximum potential. These figures are influenced by a low average volume of wood/ha, namely 123 m³ / ha and a low increment rate of 2,7 m³ / ha per year. This wood would be partly used for chopped wood and wood chips, for products from sawmills and for the woodworking industry for the production of pellets, MDF boards and pulp (Weinreich, A., 2010).

TABLE 31: WOODY BIOMASS AND OUTLOOK FOR 2020

		Conifers		Broadleaves		Total		Plan/ Increment %
Forest Area	ha	128,171		492,719		**620,890**		
	in %	21%		79%		100%		
		total	per ha	total	per ha	total	per ha	
Volume	m³	28,330,614	221	48,157,045	98	76,487,659	123	
Increment	m³/a	784,777	6.1	920,037	1.9	1,704,813	2.7	
Planned Cutting Vol.	m³/a	376,342	2.9	455,835	0.9	832,177	1.3	49%
	dry t	161,827	1.3	309,968	0.6	471,795	0.8	
Maximum Potential	MWh	841,501	6.6	1,515,742	3.1	**2,357,243**	**3.8**	
Technical Potential	m³/a	50,231	0.4	340,315	0.7	390,546	0.6	
	dry t	21,599	0.2	231,414	0.5	253,013	0.4	
53%	MWh	112,317	0.9	1,131,614	2.3	**1,243,931**	**5.5**	
Simulation of Forest		Conifers		Broadleaves		Total		
development 2020		total	per ha	total	per ha	total	per ha	%
Volume in 2020	m³	28,739,049	224	48,621,247	99	77,360,295	125	
Increment in 2020	m³/a	796,090	6.2	928,905	1.9	1,724,996	2.8	
Planned Cutting Vol.	m³/a	381,768	3.0	460,229	0.9	841,997	1.4	49%
	dry t	164,160	1.3	312,955	0.6	477,116	0.8	
Maximum Potential	MWh	853,633	6.7	1,530,352	3.1	**2,383,985**	**3.8**	
Technical Potential	m³/a	50,955	0.4	343,595	0.7	394,550	0.6	
	dry t	21,911	0.2	233,645	0.5	255,555	0.4	
53%	MWh	113,936	0.9	1,142,522	2.3	**1,256,458**	**2.0**	

Source: Weinreich, A., 2010

Montenegrin forests have due to weak maintenance a low yield but high ecological value. Forests would need intensified management for enhancement in order to produce a higher output and also to provide protection from fire, which is becoming a concern during the summer months (Weinreich, A., 2010). Better management will increase increment from 2,7 m³ to 2,8 m³ / ha per year, which is still under the Serbian average of 4 m³ / ha per year (Glavonjic B., et. al., 2009). The Austrian average is 8,2 m³ / ha per year according to a study of PEFC Austria for "Region 8" covering "Zwischen- und Innenalpen Ost" of the Tauernregion of Styria, Carinthia, Salzburg and Tyrol. (PEFC, 2006).

Nevertheless biomass is one of the most promising RES in Montenegro but needed are reliable data and professional and sustainable forest management to benefit from this technical potential in the long run. In 2020 biomass from forests could generate 1.256 GWh according to Weinreich and in this amount is not yet included biomass from agriculture which is estimated to be around 200 GWh as of today with a potential to increase until 2020. Montenegro is currently only using 1/3 of its agricultural land as productive land, what means, that the estimated 200 GWh could result into 600 GWh with more intensive land use in this sector (Nikolic,D., 2009).

The 1,200 GWh were also confirmed by a research on the biomass potential done by LUX-development in 2010 which determined, that it is possible to obtain about 1.2 million MWh of energy annually from the technically (actually) available woody biomass. Here, 1.07 million MWh represents energy from fuel wood and 0.13 million MWh (i.e.126,673 MWh) is energy from wood residue from the process of logging and wood assortment production (LUX-Development, 2010).

A different technical available biomass energy potential, but still less than the one of the Governmental expert, is presented in a study done by Hellenic Aid and USAID: The study elaborates, that "fuel wood and wood industry residues contribute equally to the forest biomass potential, while forest residues is not a negligible source of biomass (10%). The total potential equals to 3.312.210 GJ, which is 7,2% of the total primary energy supply of Montenegro." (Hellenic Aid and USAID, 2010). In this study it is also interesting to discover, that the amount of hectares of forest is much higher, than Weinreich´s evaluation of 620.000 ha. This study proclaims that Montenegro has 730.652 ha of total forest; meanwhile Weinreich considers that the provided numbers are incorrect, due to double counting of land and lack of accurate maps and statistics. The data presented by the Montenegrin officials with a biomass potential of 4.200 GWh lacks of reliable sources and cannot be accurately used for any kind of analysis. It is interesting to observe, that these data were also presented at the occasion of an Energy Community Conference in Vienna in 2010 and are part of official Montenegrin reports.

6.3.3. Support Schemes for Biomass in Comparison with Austrian Schemes

The proposed support schemes as presented in chapter 4.3. do not show any classification according to size of installed capacity nor are they accompanied by incentives for the installment of machines and equipment.

When comparing the recently adapted Austrian support schemes introduced in 2010 for energy production from biomass it shows that there will be seven instead of four classifications in order to pay attention to different sizes of equipment and facilities with different reimbursement schemes. Support schemes for RES are ranging from 10 to 14,98 c/kWh and above that further improvements and incentive schemes for investments into energy generation will be introduced, too. Also for biogas, which is not yet a topic in Montenegro, tariff classes will be limited to three (formerly five) and these support schemes will range from 13 to 18,5 c / kWh. Additional to that a bonus of 2c/kWh will be paid for the usage of waste heat (Pankratius M, 2010). The proposed Montenegrin FITs for biomass lack of adaptions and fine-tuning to the local situation of biomass production and use.

6.3.4. Long Run Generation Costs for Biomass

For the calculation of the LRGC the following parameters were applied:

C_{fuel}: 5,2 and 33,5 €/MWh with efficiency factor of 0,28 (Ecofys 2011),

Operation and Maintenance Costs per Energy Unit (CO&M): 120 €/kWel/year (Ecofys 2011)

Full Load Hours per Year (H): The load factor of 3.000 hours is taken from calculation for Montenegrin biomass plants by Danon (Danon, G, et. al., 2007)

Investment Costs per kW €/kWel (I): 2.600 €/ kW_{el} (Ecofys 2011)

Capital Recovery Factor (CRF): 6,5% and 10% for periods of 12, 20 and 30 years. The 12 year duration are reflecting the proposed period for FITs of:

Wood-processing industry	123,10 € / MWh
Forestry and agriculture	137.06€ / MWh

TABLE 32: LRGC FOR DIFFERENT CRF AND INVESTMENT COSTS OF 2.600 €/KWEL WITH FULL LOAD HOURS OF 3.000 AND CFUEL OF 5,2 AND 33,5 €/MWH

Costs for Fuel / CRF	**5,2 €/MWh**	**33,5 €/MWh**
12 Years/ 6,5%	. *147,19 €/MWh*	*155,11 €/MWh*
12 Years/ 10 %	*168,86 €/MWh*	*176,78 €/MWh*
20 Years/ 6,5%	*120,32 €/MWh*	*128,25 €/MWh*
20 Years/ 10%	*142,86 €/MWh*	*150,78 €/MWh*

The calculated LRGCs for these 8 scenarios show that the proposed FIT scheme of 123,10 €/MWh for wood processing industry is economical acceptable only for CRF of 20 years duration and with applied interest rate of 6,5% and for scenario with lower fuel costs in the amount of 5,2 €/MWh. For forestry and agriculture the proposed FIT of 137.06 €/MWh would be economical for both calculated fuel cost scenarios but only CRF of 20 years with interest rate of 6,5%.

6.4. Municipal Solid Waste (MSW)

Municipal solid waste (MSW) refers to waste collected by or on behalf of municipalities, which is originating from households, commercial enterprises, office buildings, institutions and small businesses. Waste processing and management in Montenegro is still positioned at a very low level. Waste is still disposed illegally and the collection of waste is done without separation strategies.

Also several strategy papers do not evaluate the waste amount which is produced during peak season in summer, when approximately 1 million tourists are visiting Montenegro´s coast with an average stay of 6,25 days.

6.4.1. MSW Potential

Municipal Solid Waste is not yet used for energy production, therefore only the potential can be analyzed.

One study which was done by Hellenic Aid and USAID in 2010 evaluated the waste potential as follows: Waste per capita generation expressed in kg per person and year. The study used data from Serbia, since no Montenegrin data were available. Waste originating from tourism is not taken into account. In Serbia waste per capita accounts for 312 kg/capita/year and these data were also applied for the Montenegrin calculation.

According to the EU legislation (Directive 2001/77/EC) energy produced from the biodegradable fraction of MSW is considered as renewable and therefore waste paper, textiles and organic waste are a source of biomass.

TABLE 33: MSW COMPOSITION AND LOWER HEATING VALUE OF BIODEGRADABLE COMPONENTS

	MSW Composition	Lower heating value (GJ/t)
Organic Material	30%	3,98
Paper, Paperboard	16%	11,5
Textiles	4%	14,6
TOTAL Biodegradable Fraction	50%	7,2
Plastic, Rubber, Glass, Metals, Construction Waste and other	50%	-

Source: Hellenic Aid and USAID, 2010

The theoretical potential of biomass from MSW for Montenegro was calculated according to the following equation:

Emsw = P*p*Co*Ho

P = population

P = per capita waste generation [t/yr]

Co = biodegradable waste fraction in MSW [%]

Ho = biodegradable waste lower heating value [GJ/t]

TABLE 34: THEORETICAL POTENTIAL OF BIODEGRADABLE FRACTION OF MSW IN MONTENEGRO IN 2008

Theoretical Potential of biodegradable Fraction of MSW	**2008**
Population [MONSTAT 2009]	628.804
Waste per capita (t/capita/yr)	0,312
Total Waste (t/yr)	196.187
Biodegradable fraction (%)	50
Lower heating value for bio-MSW (GJ/t)	7,2
Theoretical potential (GJ)	706.273

Source: Hellenic Aid and USAID, 2010

The main option for disposal of municipal waste is still landfilling, while in many cases existing facilities are inadequate, posing considerable risks to public health and the environment.

If we add to this calculation 1/3 of Montenegrin population for tourism, as evaluated in the statistic for inbound tourism in chapter 3.2.6. the following theoretical potential can be calculated:

706.273 plus 1/3 = 939.343 GJ

6.5. Solar Energy Assessment

Montenegro has one of the highest solar energy potential in South-Eastern Europe. The number of sunny hours equals more than 2.000 hours annually which accounts for the major part of Montenegro and more than 2.500 hours along the coastal line. These figures express, that 17-18% of annual time sun radiation can be used for the production of energy. The quantity of solar radiation is comparable to locations in Greece and Italy. Podgorica has a larger annual solar emission (1.602 kWh/m2) than Rome or Athens, for example. Currently there are no existing incentives for thermal solar energy production and no existing support schemes for the generation of electricity through photovoltaic. (Black & Veatch, 2009).

In an interview with Balkans.com in May 2011, Finance Minister Milorad Katnic stated when answering the question of interviewer Mišić:

Balkans.com: With so many days of sun, it is not only good for tourism but for energy, what is the tariff rate situation in regards to renewable energy?

Minister Katnić: Currently Montenegrin legislation does not provide for a special tax exemptions for investments in facilities and equipment used for electricity generation from renewable sources. This Government's decision is in accordance with the policy of establishing and maintaining single tax rates, without exceptions for certain activities. However, being aware of the enormous potential of the solar energy of Montenegro (number of sunny hours in the most parts of Montenegro amounts to above 2000 hrs/year, while at the coast it amounts up to 2500 hrs/year), we are currently working on finding appropriate ways for defining the fund for the provision of incentives to the system for the production of energy from renewable sources, since it is much cheaper to stimulate the electricity generation from renewable sources than the direct one (Mišić, J., 2011).

6.5.1. Status Quo of Solar Energy

The solar energy use of Montenegro in comparison with other European countries is still relatively low and limited to warm water heating, mainly for hotels and buildings along the coastal region. Solar thermal energy was relatively widely used in the coastal region before 1990, mainly for the production of sanitary hot water for hotels, residential and military premises. There was a large production and installation of solar thermal systems in the Balkans during the 80's as a wise response to the oil crisis. This political action disappeared after the collapse of the communist regime and the Balkan Wars during and after the 90´s. The current area of installed collectors in Montenegro is about 11.000 m2, with an approximately installed capacity of 5.500 kW. Mainly old collectors from the 80´s are used and they cover about 5% of needs. Taking under consideration the number of 11.000 m² of installed solar water heating systems and the current population of 620.000, these figures result into a ratio of 17 m² per 1.000 inhabitants. Montenegro has in this field a huge potential since other countries can reach several hundred m² per 1.000 habitants like in Austria, Greece, German, or Cyprus.

Under the Montenegrin climate conditions a solar heating system can provide a very high percentage (50 to 75%) of domestic hot water energy. Compared to Northern European countries, combined hot water and space heating systems provide 15-25% of the total home heating energy, which means, that Montenegro´s potential for solar heating systems is very favorable (CETMA, 2007).

Some progress is achieved with the introduction of a program called MONTESOL, which will provide affordable loans in a joint project of the Ministry of Economy in cooperation with United Nations Environmental Program (UNEP) and Italian Ministry for Environment, Land and Sea (IMELS). Offered is a financial mechanism for loans to install solar water heating (SWH) systems. Funds in the amount of 1 million USD were envisaged for project implementation and management and specifically to subsidize the interest rate of commercial banks. (Ministry of Economy of Montenegro, 2011)

This is a first step to make renewable energy systems also accessible and usable for individuals and households. Support schemes are not yet in function, but these subsidies provided by a loan program can be seen as a first step.

In Montenegro heating houses which are still not connected to the district heating system, require more than 200 kWh of energy per m2 each winter on average. Heating an apartment through a district heating system uses 115 kWh per m2 during the winter, which is still much higher than the 50–80 kWh/m2 used to heat apartments in Northern Europe. Also the use of solar architecture in compliance with energy saving mechanism would support the reduction of energy consumption. But energy prices are still very low and do not put high burden on the individual household´s income yet (CETMA, 2007).

Since more than 90 % of all Montenegrins use electricity to heat their water, the project's aim will be to replace more than 1.000 standard electric boilers by SWHs. Based is the calculations on 3 m2 of glazed flat plate collector´s area per solar system and household and a production of 150 liters of hot water per day. The program could save up to 2.000 MWh of electricity per year. This project is going to cover nine municipalities and loans will be granted for a period of 3,5 to 7 years in the amount of 1.350€, 1.800€ and 2.250 for individuals and households in Montenegro.

The use of solar technologies could therefore represent an interesting alternative to conventional systems, but heating and cooling according to the EU energy agenda in the framework of the 2020 targets are not yet gaining enough attraction among the Montenegrin society and authorities. Photovoltaic is not yet a topic to discuss, even though the potential is outstanding. No support schemes for this kind of RES are yet introduced and also the difficulties in getting grid connection might impede a fast implementation. As a matter of fact currently only island solutions with adequate storage facilities are eligible and implementable. Since PV support schemes only work with excellent decentralized grid connections, the out-of-date and partly damaged network of the Montenegrin grid represents another obstacle for fast implementation.

6.5.2. Solar Energy Potential

The following table shows the solar radiation of several major cities in the Balkan region:

TABLE 35: ANNUAL SOLAR RADIATION FOR MAJOR CITIES IN THE BALKAN REGION

COUNTRY	CITY	ENERGY in kWh/(m²/year)
Montenegro	***Podgorica***	***1.602***
Serbia	Belgrade	1.336
Macedonia	Skopje	1.368
Croatia	Zagreb	1.209
Greece	Athens	1.564
BiH	Sarajevo	1.263
Italy	Rome	1.561
Albania	Tirana	1.562

Source: CETMA, 2007

At the Energy Community workshop in Vienna in March 2010 the Montenegrin representative, Mr. Igor Kovacevic, discussed the solar energy potential of Montenegro. He evaluated the solar radiation as one of the highest in the region with 1.602 kWh/m2 per year on average in Podgorica and with sunny hours up to 2.500 hours/year (28,5%) for coastal regions. The potential for solar energy per m2/ year is estimated to be:

700 kWh /m2 /year for households

900 kWh /m2 /year for tourism

Also the industrial and commercial potential can be estimated with 800 kWh /m2 /year.

The following figures show the average daily values of Wh per m2 per day in the month of May and on a yearly basis for the territory of Montenegro:

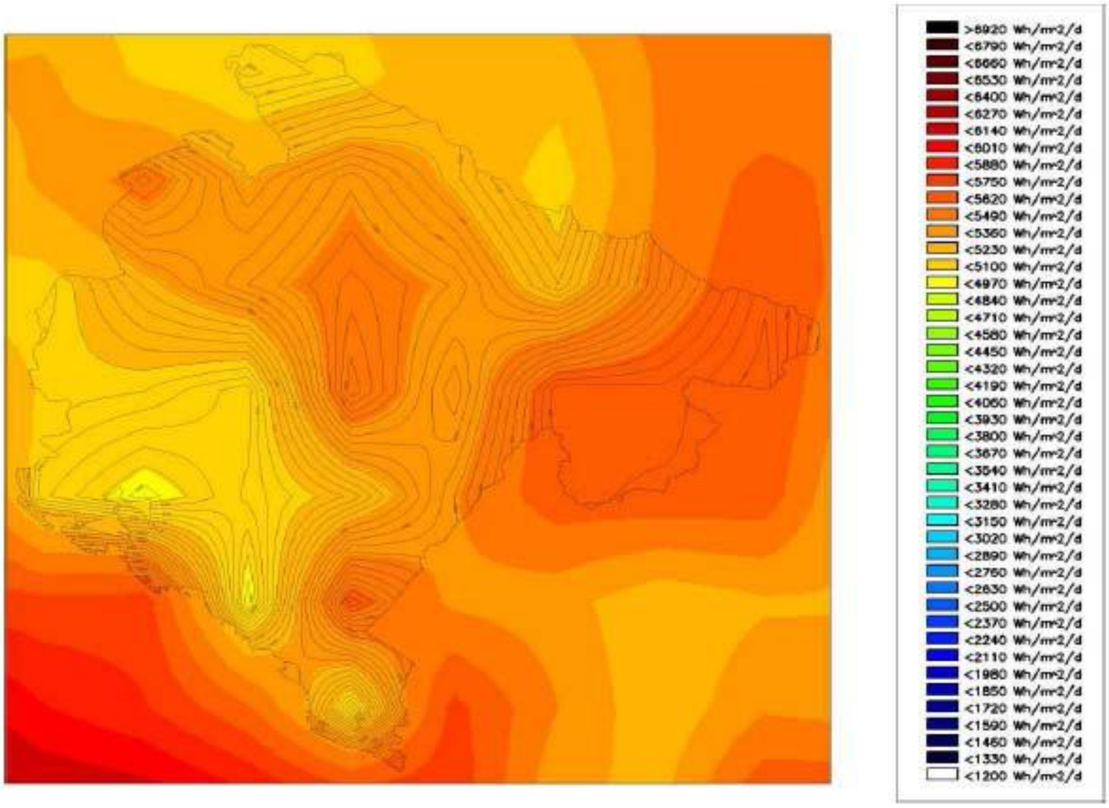


FIGURE 15: GLOBAL SUNSHINE - AVERAGE DAILY VALUES ON MONTHLY BASIS FOR THE MONTHS OF MAY.
Source: Kovacevic, I., 2010: Renewable energy sources in Montenegro, Investing in Energy Efficiency and Renewable Energy

The Wh / m2 in May are ranking between 4.870 Wh and 5.750 Wh per day per m2.

FIGURE 16: AVERAGE DAILY VALUES ON A YEARLY BASIS
Source: Markovic., M., 2009

Even the yearly average is showing significant results for solar energy generation, namely between 3.150 and 4.860 Wh/m2/d.

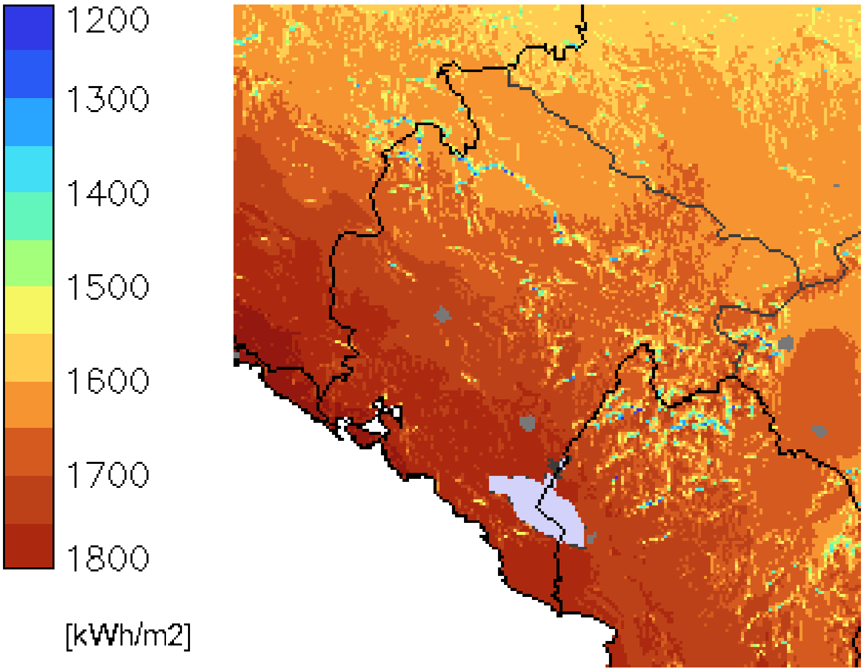


FIGURE 17: YEARLY SUM OF GLOBAL IRRADIATION PER KWH/M2
Source: Jablan N., 2010

The average amount of kWh / m2 per year is ranking between 1.400 and 1.800 kWh.

The following table is also retrieved from Mr. Kovacevic´s presentation: achievable GWh per year gained from solar heating as part of the 2020 target:

TABLE 36: ACHIEVABLE GWH PER YEAR GAINED FROM SOLAR HEATING AS PART OF THE 2020 TARGET

YEAR / GWh	2012	2014	2016	2018	2020
SOLAR THERMAL	5,0	17,0	35,0	83,0	140,0

Source: Kovacevic, I. 2010: Renewable energy sources in Montenegro, Investing in Energy Efficiency and Renewable Energy

The presented figures do not show where data are resulting from. However, 5 GWh would cover an area of 3.125 m2 solar thermal panels. In 2020 a panel area of 87.500 m2 would result into the production of 140 GWh, or 7.000 m2 of solar thermal panels per 1.000 habitants according to these figures.

Also the potential for solar electricity is outstanding and can be estimated as follows:

If we apply an average of 800 kWh/m2 for the whole country (mountain and coastal regions) as estimated by the Montenegrin experts of the Ministry of Economy then we can distinguish in between free field installments and installments on roofs and facades:
At a given population factor of 645.000 and a specific ground floor area per capita of 23 m2 (compared to 27 m2 for Western European countries), with a utilization factor for roofs of 40% and for facades of 15% the following area in km² can be used for PV installments (Resch, G. et. al., 2007):

Roofs:	5,9 km²
Facades:	2,2 km²

For free field installments in can be estimated, that 0,05% of agricultural land can be used. Montenegro has 5.180 km² of agricultural land of which 2,6 km² could be used for free field installments of PV panels with a utilization factor of 45%.
When applying 800 kWh / m2 then the following result for electricity production can be achieved:

Roof:	4,720 GWh
Facades:	1,760 GWh
Free Field:	1,170 GWh

Montenegro offers excellent solar radiation levels which would allow reaching very high energy yields. On the other hand a limited domestic market represents an obstacle to develop own production capacities and the costs for solar thermal or photo voltaic panels are without incentives still too high (CETMA, 2007). In the moment PV panels and solar thermal panels are sold in Montenegro for 40-50% higher prices than compared to Germany.

6.6. Biofuel Assessment

The EU objectives require a 10% share of biofuels until 2020 which is a compulsory part of the implemented directive. However, reality shows that there is no strategy paper for the implementation of biofuels existing. Also the public awareness in favor of biofuels is missing and it will take years to create a market for supply and demand.

Private companies do not want to invest into biofuel production, because the period of return on investment is too long. Furthermore there is no legislation existing to support biofuel production and availability of financing is also missing. Consumers are still very skeptical about these products and in the country leaded gasoline is still sold. Also the lack of technical knowhow further triggers the development and implementation of biofuel facilities as well as a general lack of a developed biofuel market in the whole area of the Western Balkans. (Nikolic, D., 2009)

6.6.1. Biofuel Potential

The production of biofuel out of used edible oil is one possibility which is identified by the Montenegrin Institute of Transportation. This biofuel could then be applied in public transport vehicles in Podgorica. Also the production of bioethanol made out of cellulosic and agricultural waste is discussed, but no date available yet. However, besides the lack of data no effort is currently denotable that biofuel might receive more attention in the country´s effort to achieve the 2020 targets for biofuel.

If we apply Serbian data from 2009 for waste edible oil in the amount of 10.000 tons / year to the figures for Montenegro the result would look as follows:

Montenegro with 1/10 of Serbia´s (7,32 Mio versus 620.000 inhabitants) population and size would account for approximately only 1.000 tons of used edible oil, which might not be enough to install production facilities.

TABLE 37: BIODIESEL 1 - RAW MATERIALS SERBIA

BIO DIESEL RAW MATERIALS
• *Raw Materials relevant to this area* - *Sunflower* - *Soya* - *Rapeseed* • *Area for raising oil seed plants – 668.800 ha* • *Area for raising oil seed plants intended for biodiesel processing – 350.000 ha* • *Waste edible oil – 10.000 t*

Source: Stojiljkovics, 2009.

TABLE 38: BIODIESEL 2 - RAW MATERIALS SERBIA

BIODIESEL RAW MATERIALS				
Oil Seed Plants	**Average Grain Yield (t/ha)**	**Oil Content in Grain (%)**	**Biodiesel Yield Kg/ha**	**l/ha**
Sunflower	1,79	40	716	816
Soya	2,25	18	405	460
Rapeseed	1,69	36	608	690

Source: Stojiljkovics, 2009

Serbia has a surface of 88.360 km² and would produce on 350.000 ha or 350 km² oil seeds for the production of biodiesel. However, these 350 km² represent 0,4% of Serbia´s land surface. If we consider Montenegro´s surface with 13.820 km², 0,4% would equal an area of 55,28 km² or 5.528 ha (Stojiljkovics D., 2009). It is questionable if production facilities for this small sized land would find investors or interested farmers. A typical Montenegrin farm consist of several hectares, which would not justify the investment and installment of harvest, procurement and storage facilities for the production of biodiesel. Estimation of Montenegrin potential of biodiesel when applying data of Serbian study:

TABLE 39: MONTENEGRIN POTENTIAL OF BIODIESEL PRODUCTION - OWN ESTIMATION IN LITERS

AMOUNT / BIODIESEL	l/ha	SERBIA (350.000 ha)	MONTENEGRO (5.528 ha)
Sunflower	816	285.600.000 l	4.510.848 l
Soya	460	161.000.000 l	2.542.880 l
Rapeseeds	690	241.500.000 l	3.814.320 l

Nikolic, the Montenegrin representative at this conference in Trieste even stated that further studies have to be conducted in order to analyze the potential for biofuels in Montenegro. Since 2009 when this workshop took place at the International Centre for Science and High Technology in Trieste, no further studies were initiated by the Montenegrin Government. As a matter of fact commercial production of industrial crops is practically nonexistent (Nikolic, D., 2009).

Montenegro has 5.180 km² (518.000 ha) of land, that could be used for farming and agricultural use. This equals 37,5% of the total surface. Actually 1.888 km² (188.800 ha) is utilized as agricultural land in the moment which accounts for 13,67% of the total land surface. Montenegro currently only uses 33% of its agricultural land for farming.

Another picture is shown by a study of Hellenic Aid and USAID, where energy crops are presented as one of the most important potential for Montenegro´s future energy production. In this study it is stated, that on an area of approx. 50.000 ha either 1.204.540 GJ from oilseeds for the use of biodiesel can be produced or with second generation bioethanol from SRC the amount of 10.045.588 GJ (Hellenic Aid and USAID, 2010).

In Serbia, where 65% of the surface of 77.474 km² is agricultural land, only 350.000 ha were estimated to be used for the production of biodiesel. Therefore the amount of 50.000 ha according to the Hellenic Aid study for Montenegro´s energy crop production might not be accurate.

Since Montenegro has according to above mentioned figures 2/3 of fallow land (Nikolic, D., 2009), there is a certain potential reachable for the production of energy corps. We also have to take under consideration, that registered land in the Montenegrin cadastral as grassland or vineyards is very often not correctly applied. Until today there are no new and accurate maps available and calculated potential should be considered and analyzed cautiously. Besides the lack of data, there is no framework or strategy paper yet available for biofuel production.

Montenegro has plenty of forests, but the production of biodiesel made out of wood waste was never a success story. The only company dealing with this procurement worldwide, namely producing wood fuel, Choren in Germany, ran out of financial means in July 2011. More than 150 million Euros were invested into this new technology, but even after 3 years of research the production of biofuel out of wood waste was not accomplished (Reuter, B., 2011).

7. Comparison with the Hungarian RES Market

Hungary is a EU member state since 2004 and obtains as Montenegro a promising potential for the production of green energy of which it can easily reach the 2020 energy and climate targets. However, the country has to be classified as energy poor. 30% of its electricity needs have to be imported. As of today fossil fuel plants produce approx. 54 % and the nuclear power plant around 38% of the domestic power generation. For the nuclear plant operation it is even planned to enlarge its generation capacity. A huge energy potential is contained in the country´s agricultural biomass and associated electricity generation through co-firing.

7.1. Status Quo of Hungarian Renewable Energy Market

Hungary has reached a share of “green electricity” of 6,2% in 2009 and the Hungarian Government set an even more ambitious target to reach 14,65% in 2020. A 250PJ/year technical exploitable potential was estimated in a background study to support the Hungarian Renewable Action Plan until 2020, with a dominant share of biomass, to a lesser extent hydropower and with a significant future share of solar and geothermal (enerCEE.net, 2011).

In 2009 the total generation of electricity from RES was 2.662 GWh according to the Hungarian Energy Office. In the Hungarian renewable energy mix biomass occupies the first place. More than 70% of renewable energy (51 068 TJ) is coming from biomass resources and firewood utilization. This is followed by biofuels (10.1%), geothermal energy (6%), renewable communal waste (5.6%), biogas (1.3%), wind (1.1%), hydropower (1.1%) and solar energy (0.2%).

Being relatively flat Hungary has limited Hydro-power potential. Rivers have 990MW theoretical power out of which 7446 GWh /year energy could be generated theoretically. On the small streams 308 GWh/year is the theoretical production.

Hungary has favorable solar conditions compared to other European countries. The number of the annual sunny hours is betwen1.900-2.200 and the average annual total of the incident sunshine is 1.300 kWh/m2. Hungary has 1.838 PJ theoretical potential and 4-10 PJ actual potential for electricity generation, but also thermal utilization can have a great significance (15 PJ/year) in the residential sector.

TABLE 40: DIFFERENT RESS AND THEIR SHARE IN TOTAL RE PRODUCTION IN HUNGARY

	Energy Production in PJ in 2010	**Share in 2010 in % of total RE Production**	**Energy Production in PJ 2010**	**Share in 2020 In % of total RE Production**
Biogas	*0,32*	*1*	*4,63*	*5*
Bio-mass	*40,74*	*83*	*60,97*	*62*
Geo-thermal	*4,23*	*9*	*16,43*	*17*
Solar	*0,25*	*1*	*3,73*	*4*
Heat-pumps	*0,25*	*0*	*5,99*	*6*
Hydro-power	*0,7*	*1*	*0,86*	*1*
Wind Energy	*2,49*	*5*	*5,56*	*5*

Source: GTAI, 2011

Biomass will stay the most important source for green energy, followed by geothermal energy sources. Biogas, heat pumps and wind will further contribute to energy production but to a much lesser amount.

TABLE 41: HUNGARY´S ENERGY POTENTIAL / YEAR

	Potential in PJ / Year
Biomass	*200*
Biogas	*n.a.*
Hydropower	*20*
Wind energy	*532*
Solar	*1,838*
Geothermal	*60*

Source: enerCEE.net, 2011

Hungary has some of the largest reserves of geothermal energy in Eastern Europe and has a minimum of 60PJ/year geothermal potential. If this resource is better exploited than even 5% of the total energy balance could be covered by thermal energy utilization.

Both countries, Hungary and Montenegro offer a great potential in biomass but are lacking of implementation of appropriate measurements and incentives. It can also be observed, that multinational players, like in Hungary the MOL group (Magyar Olaj- és Gázipari Részvénytársaság), an integrated worldwide operating oil and gas group, is simply dominating the energy market. The group is the largest company in Central and Eastern Europe with 34.000 employees and is professionally defending its own business interest. MOL group is besides its involvement in the oil and gas business a dominant player and sole producer of biofuel and is also operating the only biofuel refinery in Hungary. A similar situation is observable in Montenegro, where mainly large scale players are entering the market, as already discussed above. The Italian A2A company acquired a minority share in Montenegro´s power utility company EPCG and will also built the undersea power cable between the two countries. More decentralized systems and schemes together with appropriate subsidies should be implemented to provide opportunities for energy generation also on a smaller scale.

7.2. Supporting Policies for RES

The key areas of the Hungarian renewable energy policy are the following:

- Security of supply,
- Environmental sustainability and climate protection,
- Agriculture and rural development,
- Development of green economy,
- Contribution to Community goals.

(Biomass, 2011)

Hungary has introduced a feed-in-tariff system. The obligatory feed-in and purchase price of electricity generated from waste, from renewable energy sources or by combined heat and power production are regulated by Governmental Decree 389/2007 XII.23 (enerCEE.net, 2011).

This support scheme system will be eligible until 2020. Tariffs are set annually and are inflation corrected. The FIT system also offers additional grants through the EU structural funds. The country´s weak development of technologies generating electricity through RES is mainly caused by the dominant role of the fossil sector

(MOL) and the 100% State owned nuclear power plant in Paks in association with the relative low RES targets. RES-E deployment is lagging behind and also the lack of awareness among the Hungarian population does not contribute positively to a faster implementation. There are discussions to establish a quota system based on tradable green certificates, but nothing was realized until today. A change in government after the 2010 election caused certain delays and the new government might even cancel several schemes introduced earlier by the previous political leaders.

In 2009 the quantity of electricity sold in the framework of feed-in obligation grew by 12% (749 GWh) to 6.920 GWh compared to the previous year. 70% (67% of total electricity sales) of the total 'support' (54.6 billion HUF) was associated with co-generated electricity in 2009. Co-generation plants were producing 4.640GWh electricity (enerCEE.net, 2011).

The heating & cooling section would also offer a great potential to be explored, in particular heating, because of biomass availability and geothermal resources. Hungary´s main mean for heating is gas, which is imported from Russia through MOL group. In the combination of agriculture biogas and biomass, both energy sources could play a more dominant role for energy production in the future. The Ministry of Agriculture and Rural Development through EU structural funds has the possibility to put a focus on the implementation of associated investment incentives.

Unfortunately the expectation of the newly elected government in 2010 with regard to a broader and faster development and implementation of different support schemes was not fulfilled and there were even discussions raised to reduce subsidies and to rather double the capacity of the nuclear power plant in Paks (Pester Lloyd 11, 2011).

A modification of the current feed-in-tariff system is planned to be implemented in 2012. These ongoing discussions about modifications do neither promote RES nor do they attract investors. In Montenegro we can observe a similar, even worse situation. The ongoing discussion in Hungary offers the following changes for support schemes for Hungary:

- New and modified schemes will be introduced in 2012 with a main focus on decentralized plants and RES-H. Biomass and geothermal energy will be strongly promoted and also the production of heat.

- A new subsidy system should be introduced in 2012 and until 2030 RES-E should have a share of 15-20% and RES-H a share of 40-45%.

- The FIT schemes will be more modified and differentiated in order to meet the market demand and potential with a focus on biomass, biogas and geothermal energy.

- Also the wind energy potential should be more explored and here a main focus will be put on smaller units.
  (GTAI, 2011)

In recent years a market has developed to produce biofuel out of rape seeds and used organic oil. MOL operates together with the Austrian investor Rudi Roth (Roth Heizölgruppe) the biggest biofuel refinery in Central Europe. In 2008 135 Mio liters of biofuel were produced, 60% from rape seeds and 40% of used organic oil. 80% of the production is distributed through MOL´s own network and sold in Hungary and 20% are exported to Austria (Wirtschaftsblatt, 2009).

Since MOL is producing its own biofuel and selling it to its own gas station network, other competitors will have very small chances to participate this market, even with a small share. The main issue when producing biofuel is the existence of a guaranteed customer and buyer for the produced biofuel, which is in this case MOL by itself through its European gas station networks.

It is also interesting to observe, that investment subsidies for the period 2007-2013 from the operative program for Environment and Energy (KEOP) financed by EU funds will promote incentives for RES technologies in two main fields of green energy:

- For RES-E and heat generation the amount of € 215 million are provided, which support projects like biomass, biogas, geothermal and small scale wind turbines.

- For biofuels € 37 million are granted, which supported projects for biofuel factories with middle- and large scale capacities. This means, that all investment subsidies for biofuel are available for MOL only, since no other competitor is acting on the biofuel production market (EREC, 2009).

There are also some tax incentives for the utilization of RES in place like 0% VAT on biofuels. Hungary has a quite high VAT of 25%.

It is questionable whether it is supportive or debilitating in case MOL stays as a dominant player in the production of biofuel. The 2020 goals of a 10% biofuel share is still questionable to be achieved even though Hungary has a dominant share of 50% agricultural land out of its total area and obtains a certain potential to be utilized.

The Montenegrin RES market is lacking behind several of its neighboring countries and has not yet fully implemented its support scheme system, nor agreed on a definite 2020 climate and energy goal. Currently there are new or modified support schemes discussed in Montenegro, even though concessions for small hydro power plants and wind parks were already contracted. Constructions for small HHP or wind parks have not started yet and an ongoing adaption of these proposed schemes are impeding new investments. Montenegro also has an interesting RES potential to be explored, but similar to the Hungarian situation, mainly large-scale investments are favored by the Government. Montenegro currently favors investments into wind parks and hydro power generation, even though the solar radiation potential is one of the most promising ones in South Eastern Europe. A focus on more decentralized plants in the field of solar energy and biomass would be more favorable. In comparison with Serbia, where support schemes for all kind of power generation were implemented already in 2009, Montenegro only proposes three possible schemes in the moment. The biofuel / transport section and heating & cooling schemes are not yet in the focus. Recently investment subsidies for thermal solar panels were introduced, applicable mainly for the private sector.

7.3. Deployment Barriers

The Hungarian schemes do not offer appropriate support for the various RES options. It rather seems that implemented support schemes are not fine-tuned in order to attract users and investments. They are rather designed to protect business interests of multinational companies and the State. Administrative barriers entail very complex decision-making processes which are further impeding broader deployments of RES. Gas as a main competitor, capacity limitations for wind energy investments and no attractive provisions for biomass further hamper extensive deployment. Even though Hungary has already gained several years of experience with RES and their implementation, the situation is changing in a very slow mode.

The change of government in 2010 was actually not supporting an immediate improvement, because Hungary also faces a severe financial crisis which is more in the focus then the deployment of more appropriate RES schemes. Another influencing factor is also the lack of awareness and acceptance of RES among Hungarians, who widely accept gas import dependency from Russia and the nuclear power plant in Paks.

Montenegro is confronted with similar problems and has not yet introduced a concrete and final framework for attractive support schemes. The country is temporally delayed in the implementation of scheme and policy provisions. In this context it is also important to mention, that corruption and pre-agreed tenders are a main problem to be highlighted. Also the aluminum smelter in Podgorica is widely accepted among the population, providing jobs for 5.000 workers and their families, even though environmental problems and subsidized electricity prices will be in the long run more costly to dissolve.

It can be concluded for both countries that large scale investments are favored and the promotion of RES on a smaller and more decentralized basis with emphasis on the countries´ renewable energy potential does not take place yet.

7.4. Renewable Energy Targets

Hungary´s 2010 RES target with 3,6% was already achieved in 2005 due to biomass (REPA 2020, 2010).

Hungary´s target for 2020 is determined in the Hungarian Renewable Strategy (2007-2020) which was approved by the Parliament in April 2008 and is set for RES 13-15% in the POLICY, and 11-13% in the BAU (business-as-usual) scenario. There is no national target/commitment for RES heating and cooling (RES-H&C) yet, even though an enormous potential is existing:

TABLE 42: RENEWABLE ENERGY TARGETS FOR 2020

	2008	2020
Share of RES in Energy Mix	*4,5 %*	*14,65 %*
Electricity production of RES	*1,630 GWh*	*9,470 GWh*
Heat Production of RES	*36 PJ*	*87 PJ*

Source: ITD Hungary, 2011

- Mandatory targets by the Directive indicate the use of energy from renewable sources with a 13% share of RES of the final consumption of energy in 2020. This 13% share was in the bottom ranks of EU nations with regards to the percentage of renewables in the national mix and compared to the EU wide target of 20%.

- In final consumption at least a 10% share of renewable energy has to be achieved in transport by 2020.

- The RES Directive of 2001 determines a 3.6 % share of RES in gross electricity consumption by 2010.

- The European Biofuels Directive from 2003 calculates biofuels consumption of 5.75 % for petrol and diesel use for transport in 2010 (EREC, 2009).

In 2011 the 2020 targets were increased to 14,65% through implementation of the new Action Plan at the end of 2010 (GTAI, 2011). Interim targets were already outperformed (2005 4,3 %, 2011-2012 6,04%) and RES E will even experience a tripling of present generation levels. In solid biomass, biogas and bio waste a significant growth will be achieved. Also in the section heating & cooling biomass would contribute to considerable growth, accompanied to a lower extent by heat pumps and solar thermal heat generation. In the transport sector Hungary will try to achieve the 10% target in 2020, but with MOL dominating this market no additional competitor will enter this market. MOL will continue to produce biofuel in a monopolist position for the domestic market and a small share will be exported.

Montenegro has not yet determined its targets due to the lack of reliable data. The Energy Community has ordered an IPA funded study to evaluate the concrete biomass potential of all Parties of the Energy Community, before agreeing on targets. Montenegro is discussing a target between 23% and 30% but has to take under consideration that the KAP case is influencing this target determination. Low energy prices might trigger the formulation of the 2020 energy and climate goals, but increasing energy prices is also a very political issue (ITD Hungary, 2011).

7.5. Policies for Achieving Targets

Appropriate policies are key criterion to increase investor´s confidence. EU-member countries like Hungary should benefit from the expertise of other member countries and implement similar policies which were proven to be successful and sustainable in other member states. In general it can be stated that Hungary has policies which are offering continuity and long-term stability with technology specification, whereat this specification could be further adjusted with more structured tariffs for all available technologies. Also the guaranteed duration and an increase in tariff height would entail more investments into RES for both sections electricity and heating & cooling.

Also the elimination of administrative barriers should be part of a successful policy framework. A study has concluded that an authorization process in Hungary can last for several years, because too many authorities (30-40) are involved. Accompanied by high costs and a lack of experienced technical experts at the side of authorities is further complicating this process.

Also the status and development of spatial planning has turned out to be inefficient for RES projects and approvals are often lacking behind coding and urbanization in particular for wind energy and biomass projects. Sometimes national and local authorities do not have clear competences in these planning issues and therefore it can take years until a specific coding for a concrete project is implemented and approved.

Another important fact is the existence of concrete guidelines for authorization procedures and a clear timetable with obligatory response periods for authorities, because some project applications never receive answers. The one-stop shop is a possible solution which perfectly works in Germany and other old EU member states, but could not yet be successfully implemented at new member states´ authority levels. These kinds of solutions also require advances software applications which are often lacking inclusive trained and experienced civil servants (Resch, G., et. al., 2010).

When discussing energy efficiency measurements it is often concluded, that there is a general lack of information and its availability. Also a lack of coordinated websites is observable where architects and builders could retrieve relevant information for grants and other financial support schemes.

RES for heating & cooling will be the main contributor for renewable energy production in the future and therefore policies have to be designed in a way that remuneration for this sector will also be available as it is already the case in UK.

At this status it is difficult to discuss the situation of the Montenegrin RES schemes, because the country has not yet reached a level where support schemes were successfully implemented. Investors have already gained discouraging experience with the administrative system. Furthermore it would be important to put a focus on biomass and solar thermal heating as well as the implementation of support schemes for the electricity generation through photovoltaic. Here the German model could serve as a best practice example. RES-Heat does not play an important role, even though the potential for heat and warm water production is auspicious.

7.6. Lessons to be Learned

Hungary has the opportunity to use the knowhow and expertise of other EU member countries, which have already successfully installed large capacities of small scale projects. Geothermal, biogas, biomass and bio waste should gain more importance in the current RES schemes. Administrative barriers as a main obstacle can only be eliminated by national efforts and political will, but are often accompanied by corruption and lack of technical expertise. The strong presence and influence of MOL does not support a vast implementation of heat generating capacities and it will be questionable for how long MOL will be able to defend its business interests. The agricultural sector has a huge potential for heat and electricity generation through biomass and also for biogas production, but specific incentives have to be deployed.

However, Montenegro can benefit from a wide range of expertise mainly from foreign countries but is still struggling with the introduction of a proper support scheme system. The country´s focus is too much oriented towards large scale projects, even though it is proven in many cases that successful RES are often implemented through small scale investments and projects. A main lack is the inexperienced labor force which is not able to deal with RES projects in particular when investors are coming from abroad and are expecting to negotiate with a skilled and experienced local team. Also the lack of reliable data is a main concern. Policies should also be able to educate the population and create awareness for RES. A small country like Montenegro is able to rapidly introduce new schemes and models for the purpose of fast deployment of RES. In general it can be stated, that both countries do have as a significant problem with administrative barriers which have to be lowered, corruption and a lack of local experts. Both countries are depending on foreign investments and therefore there should be put a focus on eliminating these barriers.

8. Conclusion

Montenegro´s potential for RES is outstanding when considering hydro power, biomass and solar energy as main resources. Wind energy also offers an interesting potential to be explored as well as municipal solid waste. Biofuel production might not become too important in the country´s energy strategy, but with this potential of solar radiation it could easily switch to more electric powered cars and consider a country wide battery charging station network for these vehicles. Emobility would influence the current negative energy balance tremendously and having proclaimed an ecological State this would be a real turning point in Montenegro´s RES strategy. Therefore the country has to focus on the production of electricity out of RES, what is currently not the case.

As an EU candidate country Montenegro has to put more effort into its energy agenda in order to meet the 2020 energy and climate targets of EU. Even though the target is not finally determined, it will be very high compared to other EU member states and with increasing energy prices and effects from inbound tourism quite a challenge to be accomplished. A small country has the advantage that strategies, laws and agendas can be implemented vastly and efficiently. However, some of the biggest problems facing this accomplishment are administrative barriers and corruption.

On one hand the Energy Community puts a strong focus on large scale joint projects, but on the other hand a more decentralized approach would be more favorable and beneficial. Investments into RES by households, small scale project developers as well as local enterprises would have a sustainable effect on the country´s economy and would also contribute to educate the Montenegrin population in renewable energy related issues and deployments. Also the acceptance for green energy would increase.

There are several issues Montenegro has to resolve in order to speed up its process of implementing directives, support schemes and with the final aim of reaching the EU climate and energy target of 2020:

Final definition of the EU 2020 climate and energy target: Until today the Montenegrin Government has not yet finally approved this target, due to the lack of reliable data, the KAP case and lack of experience for calculating this target. It is discussed a target between 23% and 30%.

The unsolved KAP case is another fact, which cannot be communicated the way it is done right now, namely elaborating a case with and without KAP. Either it will be decided to close down the privatized aluminum smelter or the Montenegrin Government decides to request ecological warranties and conditions for further operation and provides possibility to produce green electricity for plant operation on site.

Inbound tourism requires a countrywide energy, water and waste strategy. The current peak season of 3 months receives approximately an additional one third of the Montenegrin population in terms of tourists (plus 222.173 in 2010) during the peak season in summer. It is planned that this number will be almost 5 times more compared to the 2010 statistics in 2020 which sums up to a million. Another problem related to this is, that municipalities tend not to cooperate among each other and a common strategy is far away from even being discussed.

The hydro power potential is very promising but in order to use this potential Montenegro has follow rather a strategy of implementing large scale hydro power plants and not only focus on the realization of small scale units, as it is currently the case. Montenegro has extensive development potential for hydropower, with a theoretical hydropower development potential of approximately 9,846GWh annually for large and 1,000GWh for small water flows.

The availability of financing small and large scale projects under the current situation of global financial crisis is impossible to achieve, in particular Montenegrin based international banks lack of liquidity and are mostly unable to provide loans.

Implementing investment subsidies for small scale renewable energy projects and providing know how and promotion: In order to promote RES and also educate the Montenegrin population towards more use of renewable energy sources it is important to promote and provide know-how and to offer affordable loans, grants or subsidies for the purchase and operation of small scale units. The current grid system is technically not able to provide a secure system for implementation of diverse support schemes and their reimbursement mechanisms. In a first step it might be rather advisable to provide financial support and/or grants for purchasing small scale units in order to initiate a broader deployment of RES.

The modernization of grid network is inevitable and should go hand in hand with implementing RES. Privatization is not always the best solution, in particular when the complete infrastructure is acquired by foreign investors. Communities and municipalities in several Western European countries are starting to buy back the once privatized grid networks.

One stop shop solution for approval and licensing of renewable energy projects are an important requirement, because approval processes are simply too long and complicated.

Reformation and updating of the cadastral system is definitely required. Currently World Bank and EU have commenced a study which should determine, what has to be changed and implemented in order to create a secure cadastral system. In the moment the Montenegrin cadastral system does not provide accurate data and is therefore not reliable for investors and financial institutions.

Increase of energy prices, implementing energy saving and energy efficiency provisions are also necessary to secure and promote investments into RES. The country´s energy intensity is 40% higher than the average of European OECD countries. However, energy efficiency and energy saving are containing a huge saving potential that could be utilized and which accounts for 20%-30% of total current energy needs.

A definite approval of support schemes should become a focus of the Montenegrin Government, because it is absurd to contract RES projects under approved support schemes and then afterwards announce again new or modified support schemes. Local as well as foreign investors need confidence and a secure investment environment when developing RES. Also the duration of support schemes with 12 years as proposed with the currently implemented FIT system is quite short. Financial institutions might require longer periods or hence ask for more equity, if schemes are not economical under the provision of a high risk market.

Long run generation cost calculations show that investments are only economical if they are calculated by applying lowest investment costs and low interest rates. Also the proposed 12 year duration for remuneration is not economical, because only longer periods show acceptable results. The worst case scenario always generates results, which make investments into the RES projects in Montenegro uneconomical. Investors should apply the worst case scenario due to country risks in order to correctly and securely evaluate an investment. Studies are not reliable and used data are mostly not appropriate, even though most of them were done by EU member countries and support.

The **availability of reliable statistics, maps and data** is definitely needed. When applying different available RES studies for this Master Thesis it was already obvious that a lack of reliable data in general is a common and huge problem. Even the 2020 target calculation cannot be verified due to unreliable data. The Energy Community is aware of this problem and has therefore tendered a new study in order to verify and analyze the actual biomass potential of its member countries. These data heavily influence the target evaluation and also the future RES strategy of Parties of the Energy Community. Biomass and related energy production for heat and electricity is the most important RES in Montenegro, but this argument is also valid for other countries of the Western Balkans.

Dismantling of administrative barriers and elimination of corruption is also claimed in several EU progress reports. An improvement would certainly attract more foreign and local investment into small and large scale renewable energy projects.

In general in can be concluded that access to energy will be one of the main issues for the future and is therefore highly positioned within the EU and related agendas. Future EU member countries can benefit from a broad range of experiences in this field and candidate countries like Montenegro should realize this advantage and opportunity EU can provide. It is not about the know-how transfer only, or about the experience gained in other EU member countries, as demonstrated with the Hungarian case. There are also financial programs provided, which offer grants and long term financing for all kinds of RES projects.

Montenegro will hopefully be able to take advantage of this support and will also be aware of the need to deal seriously with the development of its own RES potential in order to secure the availability of energy and to reduce energy dependency from imports.

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