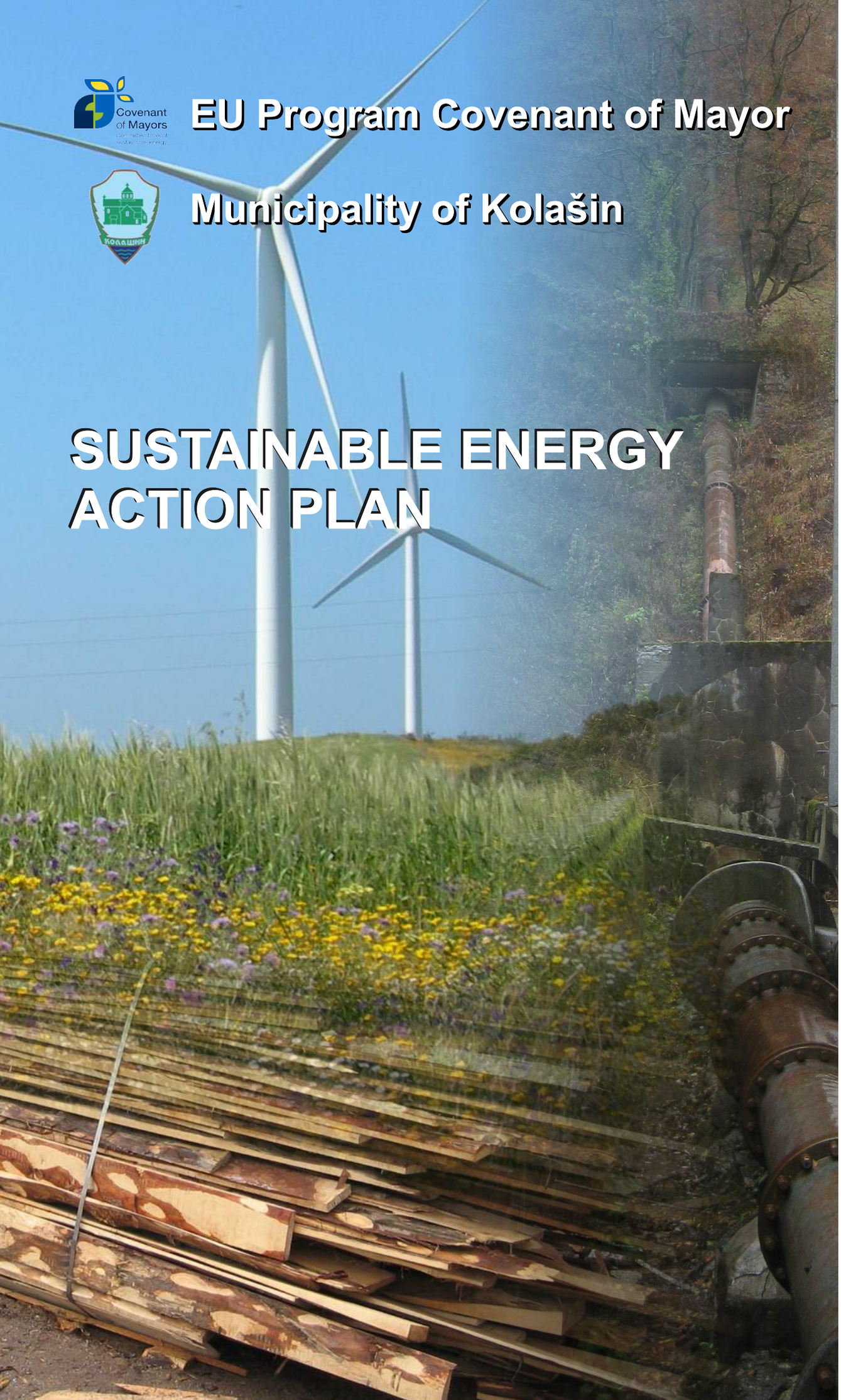

EU Program Covenant of Mayor

Municipality of Kolašin

SUSTAINABLE ENERGY ACTION PLAN

Municipality of Kolašin
Covenant of Mayors EU Program

Sustainable Energy Action Plan

ACKNOWLEDGEMENTS

The Municipality of Kolašin is committed to the sustainable development of its territory and pursues the improvement of the local population living conditions applying the principles of sustainability in the framework of a medium to long term investment planning effort based assuming key pillars such as the protection and enhancement of the environment and all the local ecological, cultural, social, and economic values. The Sustainable Energy Action Plan (SEAP) represents an important part of the above mentioned principles.

The development of SEAP would not have been possible without the support of the Ministry of Sustainable Development and Tourism of Montenegro and of the Italian Ministry for the Environment, Land and Sea (IMELS) granted through the realization of the Master Plan for the Sustainable Tourism in Kolašin

The team of experts involved in SEAP development is grateful to the work coordination performed by Mr. Mile Šuković - President of the Parliament of the Municipality and significantly supported by the staff for projects implementation of the Municipality of Kolašin, with special contribution of Mr. Mile Glavičanin and Mr Lazo Kuljić, advisors in the Municipality of Kolašin, and members of the Team for project implementation.

EXECUTIVE SUMMARY

1 INTRODUCTION

The European Commission launched a major initiative on 29 January 2008 with the aim of linking the Mayors of European cities in a permanent network in order to exchange experiences in implementing effective measures to improve the energy efficiency of urban areas and reduce CO_2 emissions by more than 20%, as foreseen by the Proposal of the European energy policy in 2007.

Covenant of Mayors is a response of the advanced European cities to the challenges of global climate change, and also the first and most ambitious initiatives of the European Commission addressed directly to active involvement and continuous participation of the local authorities and citizens in the fight against global warming.

The Municipality of Kolašin is located in the central part of Montenegro, 965 meters above the sea level. Its territory is predominantly mountainous, featuring grandiose mountains such as Bjelasica, Sinjavina and Komovi, with several peaks above 2,000 meters asl. The Municipality has a total population of around 10,000 people (3,000 of which in the city) spread in an area of about 900 km2. Average year temperature is 7.2°C, with highest temperatures of 33°C and lowest one of -32°C.

Kolašin is one of the ecologically best preserved mountainous European regions and one of the most attractive tourist destinations in the Balkans. Due to the natural characteristics of the Kolašin territory and to the inherent fragility of these environments up to now well preserved, sustainable development is crucial. The development of tourism and the increase of residential buildings in the Municipality will produce a growth of the energy consumptions and CO_2 emissions by the end of 2020. Therefore, accession to the Covenant of Mayors will enable the Municipality to face this growth implementing effective measures to improve the energy efficiency of urban areas and reduce CO_2 emissions by more than 20%, as foreseen by the Proposal of the European energy policy in 2007.

In accordance with the above mentioned commitment the Municipality of Kolašin became one of five municipalities in Montenegro which has joined the Covenant of Mayors. The proposed adhesion was unanimously approved by the City Council in April 2010. Joining this initiative, the Municipality of Kolašin committed itself to adopt a strategy for the management and the development of the local energy sector based on sustainability principles such as energy saving, efficient use of energy and generation of renewable energy with the aim of reducing the CO_2 emissions by 2020; in fact, in order to be admitted into the Covenant of Mayors each signatory shall define, approve, implement and monitor a specific Sustainable Energy Action Plan (SEAP) tailored on the actual situation and issues pertaining the energy sector of the Municipality.

2 OVERALL STRATEGY

The Sustainable Energy Action Plan (SEAP) developed according to the Covenant of Mayors template has been formally adopted and approved by the Municipality of Kolašin on April, 7th 2011. The general objective of SEAP is to conjugate the reduction of the GHG emission at municipal level and of the development of the community of Kolašin in a sustainable way; the pillar of sustainability in a proper energy policy is therefore the increase of efficiency in energy end uses, since energy efficiency is the only zero impact energy source. The main areas of intervention are two: buildings and electricity end uses. Transportation also gives a strong contribution to energy consumption.

On this basis the long-term vision of the Municipality of Kolašin foresees the development of tourism and of the community in a sustainable way: the Municipality of Kolašin will pursue electricity generation from small hydro and wind, and will work to create intelligent energy consumption, through both the use of solar and biomass energy for heat production and the increase of efficiency in heating, in street lighting and in electric equipment.

Kolašin also aim at achieving in the building sector high internal comfort standards, low energy consumption and environmental impact, together with the maintenance of shapes and materials of the traditional heritage.

Also, Kolašin vision is to develop a climate-friendly transport system based on pedestrian priority zones, biking and horse riding paths, reorganization of traffic circulation and improved access to the public transport systems.

A thorough assessment of the baseline conditions of the whole Kolašin territory was first developed involving and discussing with the local population representatives, authorities and stakeholders, estimating the natural, social and cultural potential of the area and carefully analyzing the weakness points, fragility and critical points depleting or damaging the environmental value or creating social problems currently and/or that might do it in the future.

The main critical aspects outlined are:

- large imports of energy;
- inefficient use of local available resources;
- excessive exploitation of forest resources;
- low energy efficiency in the residential and public sector.

The pillars of sustainability in a proper energy policy are both the increase of efficiency in energy end-uses, as the energy efficiency is the only zero-impact energy source, and the production of energy through low-impact renewable energy plants. Applying both principles, together with the greener transport initiatives, Kolašin could reach a significant and progressive reduction of GHG emissions, becoming the first Climate Neutral City in Montenegro.

A new, integrated energy system is needed to fulfill this vision. To this aim the main proposed actions are: electricity production from SHPP, energy production from wind, energy production and use in residential buildings (i.e use of solar energy for heat production), lamps replacement in public lighting and use of high efficiency electric appliances.

The main prerequisite for the successful realization of this process is to build effective organizational structure where will be precisely defined tasks and responsibilities of every member. Project Management Team was established within the Mayor's Office according to the Article 58 of the Statute of the Municipality of Kolašin (Official Gazette of RM - municipal regulations, No. 25/04, 31/04 and 34/06). This Team deals with preparation of project proposals and implementation of projects financed through EU and national funds, as well as with future activities related to Covenant of Mayors.

The main tasks of the Project Management Team in Sustainable Energy Action Plan include management and coordination of all phases of design, implementation and monitoring of the SEAP, the communication with stakeholders and citizens, the review of the SEAP and the preparation of periodical reports on the results of implementation of the Plan to the European Commission.

3 BASELINE EMISSION INVENTORY

The Baseline Emission Inventory (BEI) is, the first step in drafting the Sustainable Energy Action Plan and it describes the overall GHG emission registered in the municipality during the year assumed as baseline; namely 2008.

The baseline emissions of Kolašin in year 2008 have been estimated using the Greenhouse Gas (GHG) emission factor of electricity system in Montenegro estimated in accordance with the methodological tools “Tool to calculate the emission factor for an electricity system” adopted from United Nations Conventions for Climate Change (UNFCCC).

BEI results showed that the Municipality of Kolašin used 42,470 MWh in 2008 with an equivalent GHG emission volume of 20,987 tCO_2; the large majority of the energy (64%) was supplied by biomass mainly used for domestic heating and by the electric power which is largely used (22.5%); it must also be noted that all the demand of the transport sector is satisfied by fossil fuels (diesel and gasoline) as well as little part of the heating energy demand which is fulfilled by heating oil.

As shown in the following table the residential sector is the main energy consumer accounting for approximately the 80% of the total demand; while the transport related energy demand, 10% of the total requires the same energy as the industrial & commercial (4%) and tourism (5.5%) sectors together.

It must be noted that even if the residential sector remains the main contributor, its percentage drastically reduces of more than 20% since the needed energy is mostly supplied by biomass and electric power; the residential sector percentage decrease is absorbed by industry and commercial sector contribution (14.7%) as well as the tourism one (12.4%) due to the utilization of electric power and fossil fuels for energy purposes.

Baseline Energy Consumption and GHG Emissions – Year 2008

Category	Energy Consumption [MWh/y]							GHG Emission [tCO_{2eq}/y]
	Electric Energy	Liquid Gas	Heating Oil	Diesel	Gasoline	Biomass	Sector Total	
Residential	15,500	-	-	-	-	64,000	**79,500**	11,971
Tourism	2,100	100	3,300	-	-	-	**5,500**	2,599
Public	900	-	-	-	-	-	**900**	696
Industry & commercial	4,000	-	-	-	-	-	**4,000**	3,087
Transport	-	-	-	5,900	4,270	-	**10,170**	2,634
Sub-total	*22,510*	*100*	*3,300*	*5,900*	*4,270*	*64,000*	**-**	
TOTAL	**42,470**							**20,987**

The actions identified provide the key elements to implement a sustainable energy action plan for the Municipality, preparing the 'road map' for the reduction of GHG emissions.

For each relevant sector (buildings, district heating/cooling, industry, transport, local electricity production, land use planning, etc.), the selected priority actions will permit a significant and gradual reduction of the GHG emissions, towards the goal of having Kolašin as the first Climate Neutral City in Montenegro.

The key actions to be pursued in order to reach a good level of sustainability can be grouped under three measures: production of energy from renewable sources, increase of energy efficiency in end uses, promotion and management of sustainable energy.

The overall CO_2 emission reduction calculated assuming 2008 as the baseline year and taking into account the measures proposed by the SEAP amount at 5,472 tCO_2/y equal to a 26 % decrease of the GHG emissions compared to 2008 level. The estimation takes into account only the interventions for the improvement of energy efficiency and optimization of transportation in Kolašin, excluding the renewable projects which are part of a National strategy.

According to the methodology developed for the preparation of the Sustainable Energy Action Plan and in accordance with the recommendations of the European Commission, the plan of measures and actions to reduce CO_2 emissions by 2020 contains identified energy efficiency measures in the sectors of building, land use planning and other sector(s) of the Municipality of Kolašin.

The following Table 4.19provides a brief description of actions planned under the SEAP, organized according to the sectors.

Actions/ key measures per sector

Sectors	Key Actions	Energy saving [MWh/y]	Local RES production [MWh/y]	GHG reduction 2020 [t/y]
BUILDINGS, EQUIPMENT/FACILITIES & INDUSTRIES		**2,712**	**1,466**	**5,276**
Municipal buildings, equipment/facilities	*Use of solar energy for heat production*		*40*	*35*
Tertiary (non municipal) buildings, equipment/facilities	*Use of solar energy for heat production*		*550*	*1,742*
Residential buildings	*Use of solar energy for heat production*		*876*	*753*
	Use of high efficiency electric appliances	*610*		*507*
	Increase of efficiency in heating			*320*
Municipal public lighting	*Lamps replacement in street lighting*			*292*
Industries & SMEs	*Use of high efficiency electric appliances*	*2,102*		*1,627*
LAND USE PLANING				**196**
Transport/mobility planning	*Reduction of energy consumption in transport*			*196*
OTHER SECTOR(S)			**173,000**	**122,093**
Renewable Energy Production	*Electricity production from SHPP*		*115000*	*77200*
	Energy production from wind (Kljiuc)		*35000*	*27090*
	Energy production from wind (Zebalac)		*23000*	*17802*

All cities members of the Covenant of Mayors have an obligation to prepare and submit to the European Commission report on the implementation plan of priority measures and activities every two years. Continuous monitoring, control and reporting on the achieved results is extremely important component of the process of preparation, implementation and monitoring of the Sustainable Energy Action Plan of the Municipality of Kolašin.

The duties of the Municipality are to periodically check the realization of the proposed actions and to monitor the level of CO_2 emissions sector by sector and consequently to issue updates of the greenhouse gases emission inventory on regular basis.

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GLOSSARY

Acronyms

B&B	Bed and Breakfast
BEI	Baseline Emission Inventory
CDM	Clean Development Mechanism
CFL	Compact Fluorescent Lamp
CHP	Combined Heat and Power
EC	European Commission
EF	Emission Factor
EPCG	Power Utility of Montenegro (Elektro Privreda Crne Gore)
ERA	Energy Regulatory Agency
EU	European Union
GHG	Greenhouse Gases
HHV	Gross Calorific Value/Higher Heating Value
HIM	Hydro-meteorological Institute of Montenegro
HPP	Hydro Power Plant
IEA	International Energy Agency
IMELS	Italian Ministry for the Environment Land and Sea
LHV	Net Calorific Value/Lower Heating Value
LHPP	Large Hydro Power Plant
LPG	Liquefied Petroleum Gas
PPP	Private-Public-Partnerships
PV	Photovoltaic
RES	Renewable Energy Sources
SEAP	Sustainable Energy Action Plan
SHPP	Small Hydro Power Plant
WRI	World Resources Institute

Units of Measurement - Abbreviations

asl	above sea level
CO_2	Carbon Dioxide
CO2e	equivalent Carbon Dioxide
GW	Giga Watt
GWh	Giga Watt-hour
h	hour
ha	hectare
km	kilometers
km^2	square kilometers
km^3	cubic kilometers
kW	kilo Watt
kWh	kilo Watt-hour
l	liter
m	meter
m^2	square meter
m^3	cubic meter

Units of Measurement – Abbreviations (Continuation)

MW	Mega Watt
MWh	Mega Watt-hour
t	ton
tCO_2	ton of Carbon Dioxide
tCO2e	ton of equivalent Carbon Dioxide
W	Watt
y	year
%	Percentage

MUNICIPALITY OF KOLAŠIN
SUSTAINABLE ENERGY ACTION PLAN
COVENANT OF MAYORS EU PROGRAM

1 INTRODUCTION

The Municipality of Kolašin is located in the **central part of Montenegro**, 965 meters above the sea level.

The area is **well connected with both the sea and the high Montenegrin hinterland**. Its territory is crossed by the main roads connecting Podgorica to Belgrade, via Mojkovac and Bjelo Polje, in the South-North direction and Nikšić to Berane via Šavnik in the West-East direction, as showed in Figure 1.1.

The segment of the railroad Bar - Belgrade passing through Kolašin is considered as one of the most impressive and panoramic rail tracks of Europe.

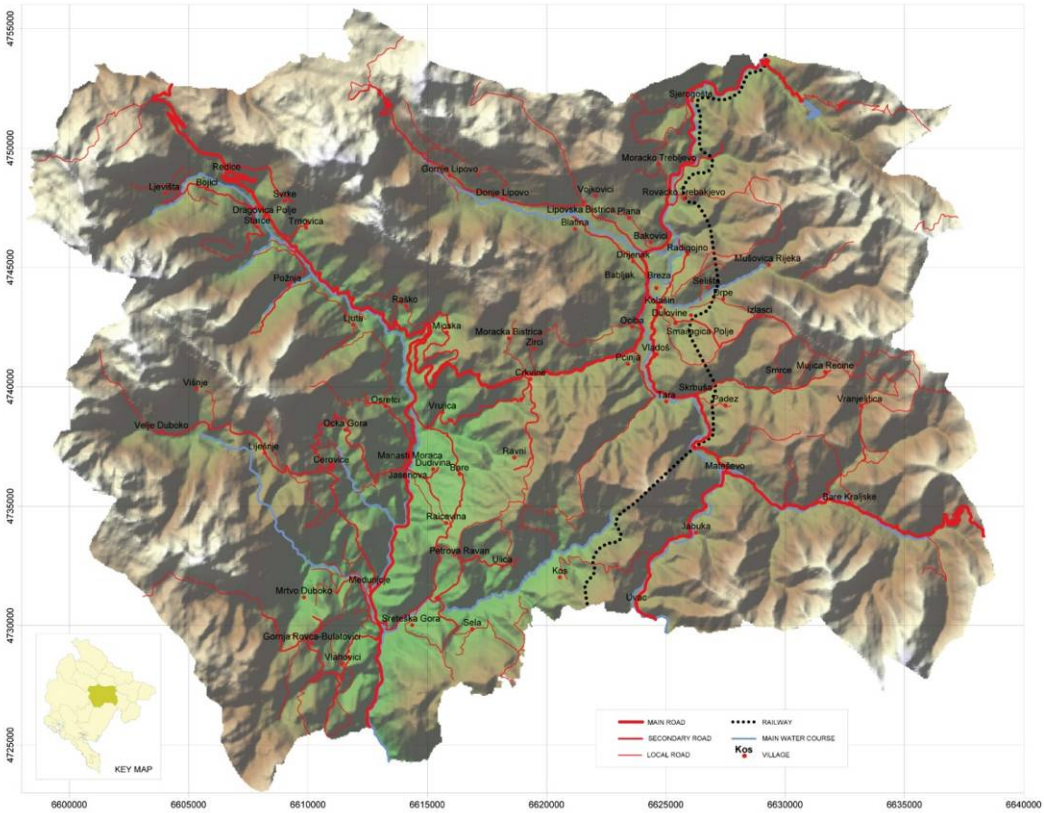
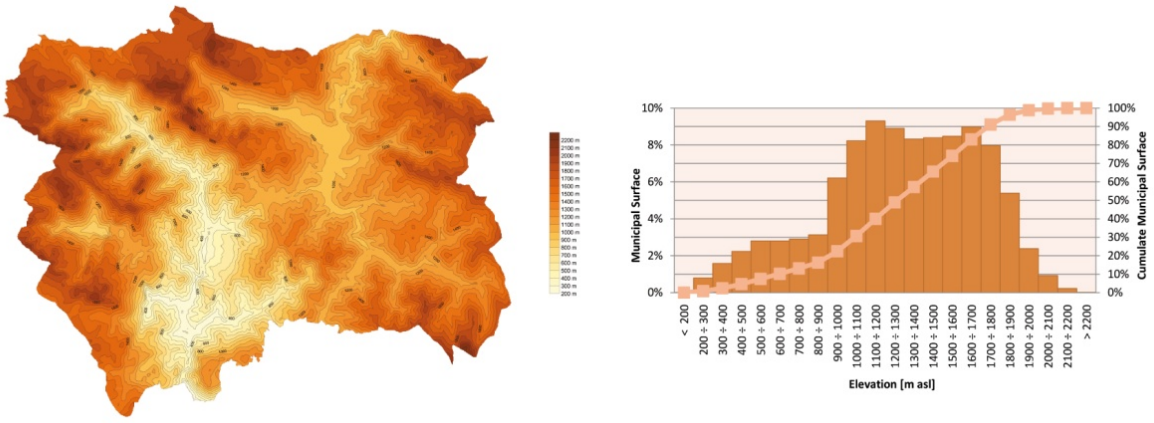
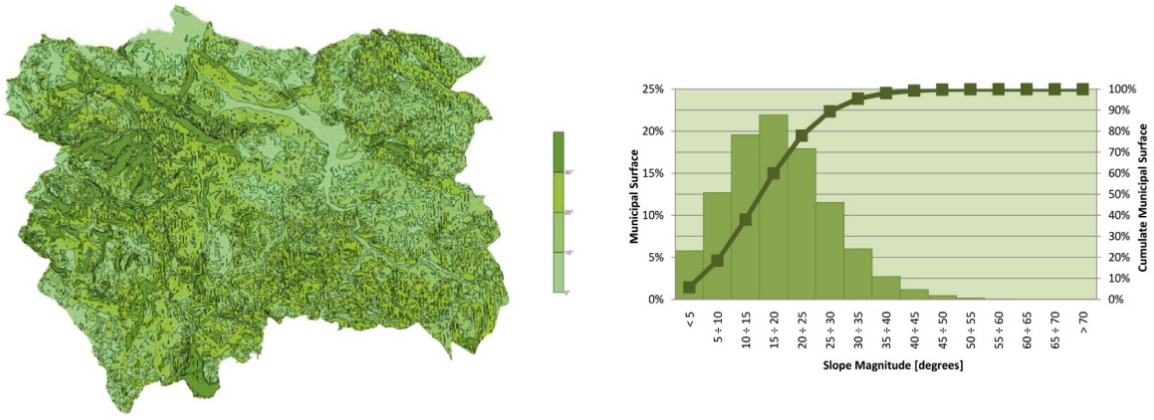


Figure 1.1: Kolašin Geographical Position

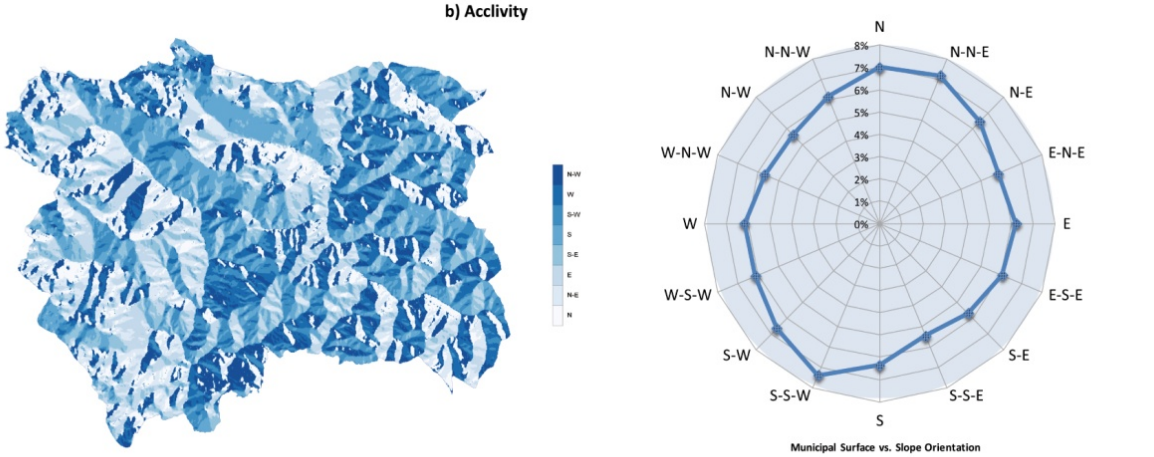
Topography is a key factor in understanding the characteristics of the Kolašin functional territory. As previously stated, the municipality is a mountain region (see Figure 1.2, Kolašin elevation, and acclivity and slope orientation): mountain relieves, with altitudes above 900 meters, are covering 83% of its overall territory. The mountain sides are quite steep, with slopes comprised between 22% and 55% (over 71 % of the municipality territory) and a valley orientation West- North West to East – South East slight predominant.



a) Elevation



b) Acclivity



c) Slope Orientation

Figure 1.2: Kolašin Morphological Features

The Municipality of Kolašin has a total population of around 10,000 people (3,000 of which in the city) spread in an area of about 900 square kilometers.

A large disparity is evident between the mountainous regions (with a reduced likelihood of demographic or economic growth) and the flat regions at the bottom of the valleys (with their concentration of urban development, agriculture, business and infrastructures).

The topography is an obvious limit to the economic possibilities of intensive use across the entire territory and represents in turn a protection to the less accessible natural environment: out of a total area of about 90,700 hectares, only about 5,000 hectares have a slope of less than 5 %.

This area is home to the largest portion of population and economic activities, crammed into about 300 hectares, while 8,000 hectares are devoted to agriculture.

This is the reason why only about **9% of the Kolašin territory is used by human activities, while the remaining is very close to its natural** status as clearly showed in Figure 1.3.

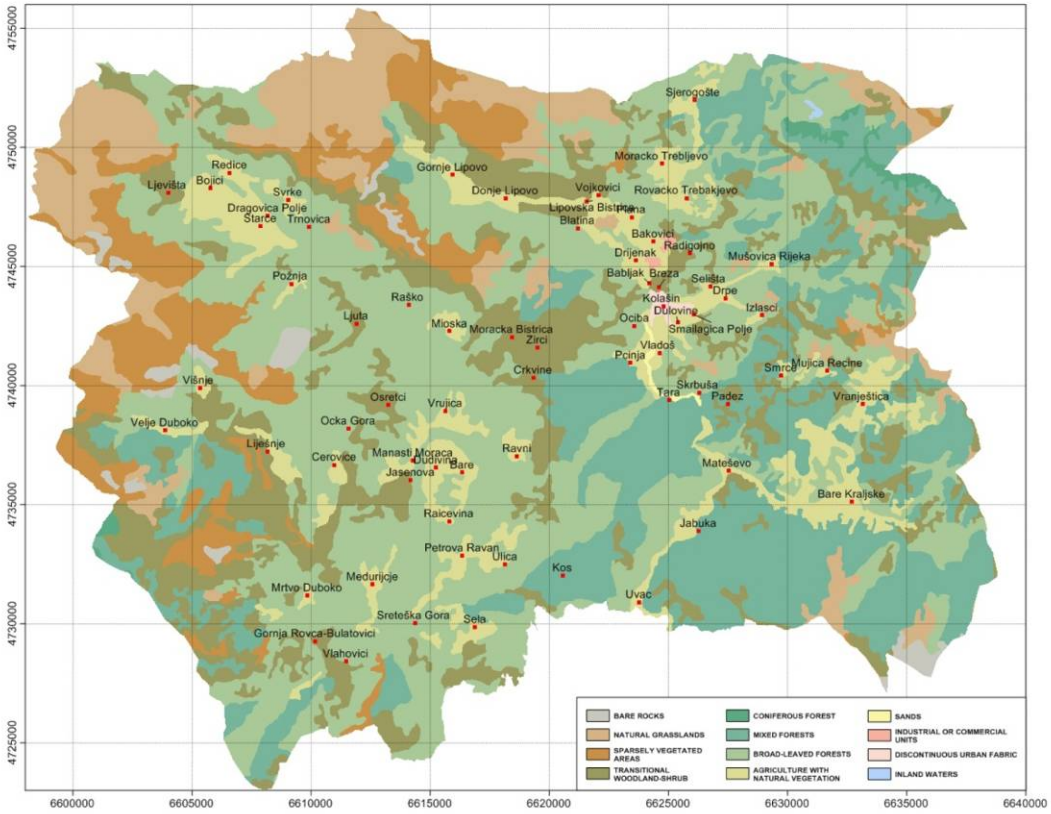


Figure 1.3: Kolašin Land use

The Kolašin territory is predominantly mountainous, featuring grandiose mountains such as Bjelasica, Sinjavina and Komovi, with several peaks above 2,000 meters.

Two main river basins are located within the municipal boundaries, i.e. the Morača River, flowing South toward Podgorica and the Skadar Lake, and the Tara River, flowing North-North West in the direction of the Bosnia and Herzegovina, where it converges with the Piva River to form the Drina River.

Both rivers feature two magnificent canyons, the Tara Canyon, starting just 30 kilometers North of Kolašin and the Morača Canyon partially comprised within the South-Western portion of the municipal territory.

In addition, one of the most spectacular places in the municipality is the Canyon of the Mrtvica River, located 35 kilometers South of Kolašin, 9 kilometers long and in some places over 1,000 meters deep.

As the soil elevation increases, the land cover is switching from agricultural and other human activities (mostly below 1,200 meter altitude along the river valleys bottom), to grasslands and sparsely vegetated areas (between 1,500 and 1,900 meters altitude) to non vegetated areas (above 1,600 meters altitude).

The climate ranges from Mediterranean, in the valley of Morača River, to moderate continental, subalpine and alpine in the Kolašin area and in the surrounding mountains. Average year temperature is 7.2°C, with highest temperatures of 33°C and lowest of -32°C.

The main natural attraction is the **National Park "Biogradska Gora" on the Bjelasica mountain**: it extends over 4,000 hectares, of which 2,600 hectares forested and the rest pastures and meadows.

It is a unique botanical garden hosting one of three preserved virgin forest of Europe and the Biogradsko Lake, located at 1,094 meters of altitude and surrounded by dedicated walking paths. Recently the spectacular alpine area of the Komovi Massif was declared Natural Park. Moreover, the areas of the Mrtvica Canyon and of the Sinjavina Massif have been designed as Emerald Sites.

In addition, Kolašin hosts an outstanding botanical garden: the great number of plant species from mountains Bjelasica, Sinjavina, Komovi, Prokletije and Durmitor represent a showcase for the **richness in flora of continental region of Montenegro**.

Healing herbs, forest fruits, and endangered species are found in this garden which beside the scientific has also an educational purpose.

The Kolašin area is **an ideal place for summer and winter sports and vacations**. Climbers and tourists are attracted by the numerous mountain peaks they can reach through many pedestrian paths.

Tourists choose for picnic places the shores of the lakes and of the rivers; rafting and canoeing in the Tara and Morača canyons are able to offer a wonderful experience.

Hunters and fishermen are also attracted in Kolašin and horseback riding and camping make the rich assortment of Kolašin tourism.

Kolašin is an excellent place for skiing and other winter sports. For the lovers of winter sports, just 8.5 km far away from Kolašin town the Jezerine ski centre offers 15 km of ski paths with a cableway 1,840 m long and 4 ski lifts.

Kolašin is also **rich in cultural/historical attractions**, first of all the Morača Monastery, featuring remnants from the past such as painted frescoes and a wood-carved altar dating the 16th century.

Kolašin is strongly committed to the protection of environment and sustainable use of natural resources due to the natural characteristics of its territory and to the inherent fragility of its environmental values up to now well preserved. In accordance with the abovementioned commitment the Municipality of Kolašin became one of five municipalities in Montenegro which has joined the Covenant of Mayors. The proposed adhesion was unanimously approved by the City Council in April 2010.

Joining this initiative, the Municipality of Kolašin committed itself to adopt a strategy for the management and the development of the local energy sector based on sustainability principles such as energy saving, efficient use of energy and generation of renewable energy with the aim of reducing the CO_2 emissions by 2020; in fact, in order to be admitted into the Covenant of Mayors each signatory shall define, approve, implement and monitor a specific Sustainable Energy Action Plan (SEAP) tailored on the actual situation and issues pertaining the energy sector of the Municipality.

SEAP is therefore a key document that demonstrates how the administration intends to achieve the objectives of reducing CO_2 emissions by 2020 identifying the best fields of action and opportunities, defining concrete reduction measures, together with time frames and assigned responsibilities, which translate the long-term strategy into actions which will cover both the public and private sectors, with initiatives on the urban environment and infrastructures including new buildings, public lighting, electricity grids, the urban and regional planning, the generation of energy through renewable resources, the development of policies for sustainable urban mobility, etc.

In addition, taking into account the wide range of sectors potentially involved by the implementation of the SEAP and the consequent impact on the population, the development of the SEAP envisages a continuous consultation with all the relevant stakeholders including citizens in general and the civil society, in order to facilitate the conscious acceptance of intelligent behavior in terms of energy consumption.

In accordance with the Covenant of Mayors' Guidebook on how to develop a SEAP, the present document has been structured as follows:

- in Section 2 are presented the overall strategy set by the Municipality to reduce the CO_2 emissions, the main objectives and target of the SEAP and the organizational and financial aspects;
- Section 3 describes the results of the Baseline Emission Inventory (BEI). The BEI quantifies energy flows and the amount of CO_2 emitted due to energy consumption in the territory of the Municipality of Kolašin in the baseline year 2008, serving thereby as the reference against which the reduction targets and the actual achievements of individual actions and related emission reductions in 2020 shall be monitored and compared. It must be noted that in order to set realistic goals of energy saving and CO_2 emissions reduction by 2020;
- the planned actions and measures are presented in Section 4; the description of the actions provide an estimation of the resulting CO_2 emissions reduction at municipal level, the timeframe for implementation until the 2020 and the body responsible for their implementation is the Municipality of Kolašin.

The Sustainable Energy Action Plan developed according to the Covenant of Mayors template has been formally **adopted and approved by the Municipality of Kolašin on April, 7th 2011**.

2 OVERALL STRATEGY

The general objective of this Action Plan is to conjugate the reduction of the GHG emission at municipal level and of the development of the community of Kolašin in a sustainable way, which means preservation of the natural heritage for the next generations, economic development and social fairness.

Energy is of fundamental importance within sustainable development. Fossil fuels are the main cause of greenhouse gases emissions, causing the Global Warming, the main global environmental problem currently faced by mankind. Beside carbon emissions, combustion also releases large amounts of toxic and polluting emissions, among them nitrogen and sulphur oxides, carbon monoxide and fine dusts. Moreover, especially for oil and natural gas, fossil fuels are available in finite amounts and they will become in the future more and more expensive.

Also Renewable Energy Sources (RES) have an impact on the environment. In particular, large hydro power plants have a wasting impact on river ecosystems, wind power plants have an impact on landscape and, sometimes, on bird fauna, biomass can contribute to air pollution due to the products of its combustion. Moreover, costs of renewable energy production are usually higher than those of fossil fuels, even if growing prices of the latter and technology improvement of RES makes them more and more convenient. These sources remain by far much preferable to fossil fuels or nuclear, but it is important to highlight that their impact is not zero.

The pillar of sustainability in a proper energy policy is therefore the increase of efficiency in energy end uses, since energy efficiency is the only zero impact energy source. Today's technologies allow huge energy savings in all sectors, they can be introduced in Kolašin and in all Montenegro and the economic savings following energy savings quickly repay the investment needed to install them.

The analysis of the current situation and of the trends of Kolašin showed many opportunities in the energy field, as well as many risks.

The main areas of intervention are two: buildings and electricity end uses.

Transportation also gives a strong contribution to energy consumption. Technology has yet not found a sustainable alternative to oil products for running a car. Mobility through collective transportation systems needs 5 to 20 times less energy than the private car, whereas walking and biking only require human force. It is therefore of fundamental importance, in this field, to design the future development of Kolašin as a compact and accessible city, where inhabitants and tourists find a pleasant environment for moving walking or cycling through it instead of taking their car.

In order to illustrate the overall strategy adopted by the Municipality to meet the GHG emissions reduction target in the following are described:

- the sustainable energy vision until 2020;
- the current situation of the energy sector;
- the action plan objectives and the GHG emission reduction target to be met in 2020;
- the organizational structures and the financial aspects.

The main elements of the overall strategy summarized in the SEAP template are presented in the Appendix A.

2.1 SUSTAINABLE ENERGY VISION FOR 2020

The long-term vision of the Municipality of Kolašin foresees the development of tourism and of the community in a sustainable way. Energy is fundamental within the sustainable development. The analysis of the current situation of Kolašin showed many opportunities in the energy field. In its vision for sustainable energy future the Municipality of Kolašin will pursue electricity generation from small hydro and wind, and will work to create intelligent energy consumption, through both the use of solar and biomass energy for heat production and the increase of efficiency in heating, in street lighting and in electric equipment.

Aim of Kolašin in the field of buildings is to achieve, in new constructions and renovation works, high internal comfort standards, low energy consumption and environmental impact, together with the maintenance of shapes and materials of the traditional heritage.

Also, Kolašin vision is to develop a climate-friendly transport system based on pedestrian priority zones, biking and horse riding paths, reorganization of traffic circulation and improved access to the public transport systems.

2.2 CURRENT FRAMEWORK

Following a fruitful discussion with the local population representatives, authorities and stakeholders, **a thorough assessment of the baseline conditions of the whole Kolašin territory was first developed**, estimating the natural, social and cultural potential of the area and carefully analyzing the weakness points, fragility and critical points depleting or damaging the environmental value or creating social problems currently and/or that might do it in the future. The following sections are dedicated to a comprehensive presentation of the main key issues.

2.2.1 Large Imports of Energy

Energy efficiency and renewable energy are fundamental issues in the framework of sustainable development. The current trend of energy production and consumption within the Municipality of Kolašin presents several critical aspects: **heavy reliance on electricity and fuel imports, excessive exploitation of forest resources**, with big quantities of cut wood not used (branches and sawmill residues), **abundant solar availability not exploited** (see Figure 2.1**) and low energy efficiency in the end uses**.

2.2.2 Inefficent Use of Local Available Resources

Kolašin has **significant potential in renewable energy resources** including hydro, solar, wind energy and wood biomass within its territory; nevertheless, none of them is adequately utilized at the moment. **Only one Small Hydro Power Plant is currently operating** within the Municipality, producing at full capacity only 30% of the average electricity demand of Kolašin. The remaining energy demand of the Municipality is thus satisfied by imports.

The highest potential is probably related to hydro power plants: beside the existing Mušovića Rijeka power plant, some studies have already been developed for the realization of new hydro power plants, both large and small in size. In particular, the installation of the largest project, foreseen on the Morača and Tara River through the realization of huge dams, could have negative consequences from the environmental point of view: the plant would subtract, in fact, a very large amount of the water resources to the Tara River, which would be strongly affected by the project over its whole length in the Montenegrin territory, whereas the beautiful canyon of the Morača River will be completely flooded and occupied by the dam.

To date, **there are no projects for wind energy use within the Municipality of Kolašin, but wind power could present interesting development possibilities at two sites**, thus contributing to the reduction of energy imports and of fuel consumptions.

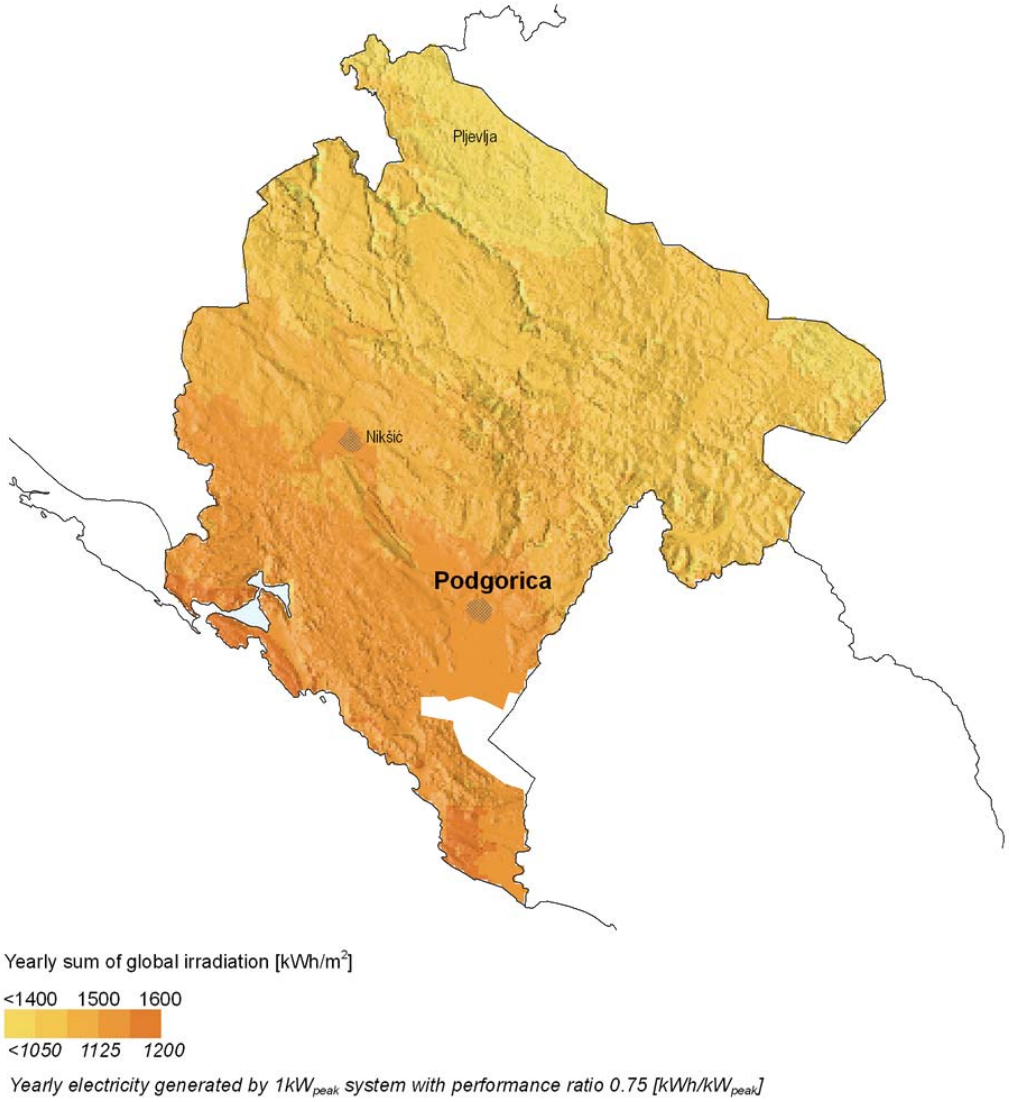


Figure 2.1: Solar Potential Currently available for Energy Generation

2.2.3 Excessive Exploitation of Forest Resources

Biomass potential, mostly related to wood and wood residues, is high overexploited due to the presence of heavy illegal cutting activities. Their use should be better regulated and controlled, since probably the amount of wood really exploitable, without reducing quality of forests, is lower than what is currently used. Nevertheless, the way in which the wood chain is currently organized could be enhanced in order to reduce wood wastes and re-use them as fuel in modern automatic heat generators, thus reducing the needs of fuel wood. For

example, a lot of wood residues are abandoned in forests after the cutting operations in form of logs and branches and other residues come from sawmills operations in forms of swarfs and sawdust.

2.2.4 Low Energy Efficiency in the Residential and Public Sector

Solar energy is currently not used at all, although the yearly insulation of Kolašin is fairly good. At present, hot water heating in the residential sector of Kolašin is mainly generated through electric boilers. It is expected that in the next years domestic hot water consumption will significantly increase as the standards of living are improved. It implies that the electric boilers will consume too much electricity, far from being a sustainable solution. The huge potential for solar energy for hot water production in the residential sector is seen as a priority for Kolašin.

Large amounts of energy are currently wasted due to low efficiency of energy using appliances. Specifically, the main areas of intervention are two: buildings (space heating and domestic hot water production), and electricity end uses. In single family houses, **heating plants generally rely on firewood as the main heating source**. In most houses there is a stove in the kitchen, and no heat distribution in the other rooms. The stove is also commonly used for cooking during the heating season. In some houses, water heating stoves are used, which allow heat distribution through radiators in other 2-3 rooms, but most houses do not have this system.

Therefore, **electric stoves are widely used in households**. Stoves are of traditional type, usually run with wood pieces and rarely with coal. This kind of heating system has a low efficiency: only around 60-70% of the heat is distributed, whereas the rest flows through the chimney. Moreover, the room hosting the stove is overheated, whereas the rest of the home remains cold. **Hot water is produced using electric boilers,** and cookers are electric. Liquid gas in cylinders is rarely used in single homes for heating, hot water preparation and cooking.

The situation is different in larger buildings, like hotels. **In hotels the most common system is a centralized boiler for heating hot water**, distributing heat to the rooms through radiators. The common fuels used are traditionally wood and, to a much lesser extent, coal, whereas in more modern plants mazut and fuel oil are used.

The current trend is a shift to liquid gas, since it allows much lower expenses, higher efficiency and better tuning of heat production. Mechanical ventilation systems are not commonly used, apart for some common spaces in the main two hotels, which have state-of-the-art plants: the ventilation system is integrated with heating, heating in rooms is made through radiators equipped with thermostatic valves and water and energy consumption is continuously monitored by a Building Management System (BMS). However, out of the heating season hot water and cooking rely on electric systems also in large buildings.

Therefore, the increase of efficiency in energy end uses is a key measure to be implemented in a proper energy policy, since energy efficiency is the only zero impact energy source. Today's technologies allow huge energy savings in all sectors; they can be introduced in Kolašin and in all Montenegro and the economic savings following energy savings quickly repay the investment needed to install them.

Transportation also gives a strong contribution to energy consumption. Technology still has not found a sustainable alternative to oil products for running a vehicle. Mobility through collective transportation systems needs 5 to 20 times less energy than the private car, whereas walking and biking only require human force. It is therefore of fundamental

importance, in this field, to design the future development of Kolašin as a compact and accessible city, where inhabitants and tourists can find a pleasant environment for moving, walking or cycling instead of using their cars.

2.3 ACTION PLAN OBJECTIVES AND GHG EMISSIONS REDUCTION TARGET

The strategic vision of the Municipality is based on the principles of sustainable development, focused on accelerating economic growth through strengthening the tourism sector in the Municipality, on respecting the sustainable energy principles, ensuring environmental protection and rational use of the natural resources, promoting at the same time an alliance between development and environment and taking into account the right of future generations to quality of life.

Energy efficiency and renewable energy resources are fundamental issues in the framework of sustainable development of the Municipality of Kolašin. Principles of sustainable energy development are based on accelerated but the rational use of its own energy resources, respecting the principles of environmental protection, improving energy efficiency and greater use of renewable energy sources.

The pillars of sustainability in a proper energy policy are both the increase of efficiency in energy end-uses, as the energy efficiency is the only zero-impact energy source, and the production of energy through low-impact renewable energy plants. Applying both principles, together with the greener transport initiatives, Kolašin could reach a significant and progressive reduction of GHG emissions, becoming the first Climate Neutral City in Montenegro. A new, integrated energy system is needed to fulfill this vision.

The Action Plan objectives to be met in order to reduce GHG emissions can be summarized as: increase of efficiency (i.e.: energy savings) and production of energy through low impact renewable energy plants. To this aim the main proposed actions are: electricity production from SHPP, energy production from wind, energy production and use in residential buildings (i.e use of solar energy for heat production), lamps replacement in public lighting and use of high efficiency electric appliances.

It must also be noted that the development of tourism and the increase of residential buildings foreseen by the end of 2020 involve a growth of the energy consumptions and CO_2 emissions.

The Municipality has the duty to face this growth through adequate actions consisting in the adoption of new technologies (i.e. the use of solar thermal systems for the hot water production), the use of high efficiency electric equipment (i.e. fridge, washing machine), the reduction of energy consumption in transport (i.e. electric minibus service within the urban area, bicycle/pedestrian paths).

The overall CO_2 emission reduction calculated assuming 2008 as the baseline year and taking into account the measures proposed by the SEAP amount at 5,472 tCO_2/y equal to a 26 % decrease of the GHG emissions compared to 2008 level; it must be noted that the estimation takes into account only the interventions of energy efficiency in Kolašin, excluding the renewable projects which are part of a National strategy.

2.3.1 Production of Energy from Renewable Sources

The territory of Kolašin is rich in renewable energy sources, with abundance of water, wind, wood and sun. General objective of the Action Plan in the energy sector is to encourage the

use of local available renewable sources, thus avoiding the dependence on fossil fuels or on obsolete electric appliances.

Although only one small hydro power plant is currently operating, there is plenty of large and small potential hydropower sites throughout the Municipality (see Figure 2.2). If all these proposed power plants are built, the aspect of territory of the Municipality will become a kind of artificial Finnish landscape: two large reservoirs on the Morača (plus two adjacent in the Municipality of Podgorica) and two on the Tara, eight smaller artificial lakes spread throughout the upper Morača and its tributaries, further catchment weirs along smaller creeks in the Tara Valley: altogether twelve reservoirs, which would probably produce more than half of the energy used throughout the whole country. Such a scenario, although based on a huge production of renewable energy, is far away from sustainability, being the large hydro power system on the Morača River under evaluation in all national planning documents.

Wind resources of the Kolašin territory generally are not the best of Montenegro, but many ridges present good wind conditions. **Based on the Wind Atlas of Montenegro, two suitable locations for wind farm development have been identified and the power generation has been estimated.**

Forests, although broad and valuable, are already exploited both for commercial wood production and for energy use (firewood). Exploitation levels are very high, and considering the broad illegal cutting activities they are probably higher than their natural renewal rate. Thus, the objective on biomass production is not to cut more wood from forests, but to use it better. Large amounts of wood waste are currently produced and not used, both in forests (logs and branches) and at sawmills (swarfs and sawdust). These residues, when properly collected and recovered, can represent a first level energy source for feeding wood chips stoves, and in perspective for producing pellets.

Figure 2.2: Detail of the Mušovića Rijeka Small Hydro Power Plant

Also solar energy, currently not exploited, shows large opportunities of development, due to the good solar radiation (see Figure 2.1) especially in the summer season. Its use for electricity production is considered premature, because of high prices and seasonal

availability of the radiation. Photovoltaic plants are still very expensive and, in absence of strong subsidies (there are no incentives for photovoltaic at national level), they can be interesting just for a few niche applications, such as for supplying small amounts of electricity in remote places. On the contrary, the use of solar systems for hot water production has demonstrated to be economically profitable, supplying 70-80% of yearly hot water needs. Hot water production is currently responsible of about 40% of electricity bills, thus, in perspective, solar thermal could allow a reduction of 30% in energy bills. On this basis, our goal is to promote and disseminate the use of the solar thermal technology. To this aim, it is necessary to gradually create a demand and to form, through dedicated training courses, skilled technicians able to satisfy the demand.

2.3.2 Increase of Energy Efficiency in End Uses

Energy efficiency in final uses is the most important part of a sustainable energy policy.

The high yearly wood demand for heating in Kolašin points out that the plants efficiency is quite low and the insulation of households is scarce. Thus, **buildings need better insulation and more efficient heating plants**.

The Improvement of Thermal Insulation could be realized on new constructions but also through the renewal of existing buildings. A thick insulation layer on the external side of the walls (see Figure 2.3), covered with plaster or wood, should be put on the façades. Also roofs should be insulated with a thick insulating sheet below the tiles. Thermal bridges are high thermal conductivity elements connecting internal and external environments. In new buildings, **thermal bridges should be avoided**.

Figure 2.3: Thick External Insulation Layer in New Building in Breza

Plants can also play an important role for the enhancement of energy performance and internal comfort. **Electricity consumption for domestic hot water production could be significantly reduced by the introduction of Solar Thermal Equipment. A family of four people in Kolašin could satisfy 70-80% of its hot water needs through a solar thermal plant made with 4 m^2 solar collectors** (see Figure 2.4**) and a 250 liters storage tank.** This would imply a reduction of 30-40% in the electricity bill for families, and similar results could be also obtained for tourist structures.

Figure 2.4: Examples of Installation of Renewable Energy Plants

The Installation of Biomass Boilers for Heating will contribute to reduce energy demand for space heating. These systems would maintain the traditional use of wood as primary heating source, introducing at the same time many improvements: modern wood chips and wood pellet boilers and stoves can work automatically, being fed by a fuel tank allowing operation for days or even weeks or seasons. Also power can be tuned, thus allowing optimal operation following external weather conditions changes. Beside hot air or hot water for heating, biomass boilers can also produce domestic hot water when solar energy alone is not sufficient to satisfy the demand. These plants work with materials derived from wood waste. Other biomass boilers can work with normal firewood pieces and briquettes, as conventional stoves. Modern biomass stoves are also more efficient than conventional ones, and the polluting emissions (especially dust, carbon monoxide and nitrogen oxides) are typically ten times lower.

The use of Controlled Air Ventilation with Energy Recovery will also contribute to the improvement of air quality, energy recovery and heat distribution. Indoor air quality tends to improve through frequent air changes, usually made opening windows, or through passive air distribution lines, with poor control possibilities. The use of mechanical ventilation would allow a better tuning of air changes. A good system would work extracting exhaust air from bathrooms and kitchen, and insufflating fresh air into the rooms. Heat recovery would be possible by an inverse flow heat exchanger between the two flows. Incoming air could be heated, after this exchanger, by a further heat exchanger between air and a hot water flow coming from the boiler, thus allowing a good heat distribution throughout the house, using cheap air ducts instead of an expensive radiator-based hot water distribution system. As for electricity consumption, electricity bills are currently nearly double than in Italy. The main reason is that most of the typical devices in households are electric heaters and electric boilers for hot water production. Another important reason is the relatively high consumption of electricity in both households and street lighting. Further important electricity consumption takes place in public lighting. **Shifting to a highly efficient lighting system will allow the Municipality reducing expenses, besides saving energy.** The development of Kolašin as a compact city will also allow avoiding large extensions of the public lighting network, thus sparing high installation and operation expenses and lighting pollution.

The objective of the Action Plan as for electricity consumption will be the introduction of energy labels, efficient households and the rapid diffusion of efficient lamps. Sustainable transportation measures are reported in the section on "Greener Transport". Our Action Plan focuses on structural interventions for greening the transport sector, whose main results will be achieved in the long term period, even though valuable effects will be also noticed in the short term.

2.3.3 Reduction in Greenhouse Gases Emissions

Both energy efficiency and the use of renewable sources give a strong contribution to the replacement of fossil fuels and consequently to pursue a third fundamental objective: the reduction in greenhouse gases emissions. The actions identified for energy efficiency and renewable provide the key elements to implement a sustainable energy action plan for the Municipality, preparing the 'road map' for the reduction of GHG emissions. For each relevant sector (buildings, district heating/cooling, industry, transport, local electricity production, land use planning, etc.), the selected priority actions will permit a significant and gradual reduction of the GHG emissions, towards the goal of having Kolašin as the first Climate Neutral City in Montenegro. It is recognized that powerful capacity building activities and awareness raising campaigns are needed to implement these objectives, in parallel with the implementation of the proposed measures. Trainings for technicians and designers must create a local offer of services and products in the sector, whereas pilot projects must create a start-up marked demand. Awareness raising campaigns are needed to speed up and broaden the demand growth for sustainable energy market.

As previously stated **the overall CO_2 emission reduction calculated assuming 2008 as the baseline year and taking into account the measures proposed by the SEAP amount at 5,472 tCO_2/y equal to a 26 % decrease of the GHG emissions compared to 2008 level**.

2.4 ORGANISATIONAL AND FINANCIAL ASPECTS

2.4.1 Coordination and Organisational Structures

The process of designing, implementing and monitoring the Sustainable Energy Action Plan of the Municipality of Kolašin is a complex task that would set up a number of challenges to all of its participants. The main prerequisite for the successful realization of the process is to build effective organizational structure where will be precisely defined tasks and responsibilities of every member.

Project Management Team was established within the Mayor's Office according to the Article 58 of the Statute of the Municipality of Kolašin (Official Gazette of RM - municipal regulations, No. 25/04, 31/04 and 34/06). This Team deals with preparation of project proposals and implementation of projects financed through EU and national funds, as well as with future activities related to Covenant of Mayors.

The first step in establishing the organizational structure for the process is designation of the coordinator. The coordinator of the Team is a key person who makes all important decisions on coordination and implementation of concrete projects and energy efficiency measures, renewable energy sources and environmental protection in accordance with priority measures and activities in the Sustainable Energy Action Plan.

This Plan foresees that the coordinator of the Team is President of the Assembly of the Municipality of Kolašin.

2.4.2 Staff Capacity Allocated

Project Management Team is composed of 9 members, headed by the President of the Assembly of Kolašin as coordinator of the Team. Team members have experience in gathering project ideas, providing advisory and consulting services to potential applicants, as well as in preparation, management and implementation of projects and their evaluation.

The main tasks of the Project Management Team in SEAP include:

- management and coordination of all phases of design, implementation and monitoring of the Sustainable Energy Action Plan;
- communication with stakeholders and citizens;
- review of the Sustainable Energy Action Plan and
- preparation of periodical reports on the results of implementation of the Sustainable Energy Action Plan to the European Commission.

2.4.3 Involvement of Stakeholders and Citizens

Direct involvement of stakeholders in the process of designing the Sustainable Energy Action Plan was implemented from the very start of the process. The Action Plan for sustainable tourism development of the Municipality of Kolašin, which includes detailed monograph on energy sector in the Municipality, upon which the Sustainable Energy Action Plan is based, has been widely discussed with stakeholders.

In 2008-2009 years number of meetings was held in Kolašin regarding preparation of the Master Plan for sustainable tourism development, attended by representatives of public administration, businesses and citizens. On February 2010 the Master Plan was presented in Kolašin, in cooperation with Ministry of Tourism of Montenegro, Italian Ministry of Environment, Land and Sea and the Municipality of Kolašin. Furthermore, Montenegro participated in the Expo 2010 in Shanghai, where the Minister presented the Master Plan.

Those events were very important for sharing with other institutions, stakeholders and citizens the future vision of the Municipality and the main objectives and foreseen activities in the Action Plan, including also main objectives, analysis, proposed measures and activities in energy sector of the Municipality.

2.4.4 Budget and Financing Sources for the Investments

An overall budget was not estimated. Detailed budget for each action described in the Sustainable Energy Action Plan template will be evaluated through accurate technical and economic feasibility studies.

The budget is the main financial document of the Municipality of Kolašin, which represents revenues and expenditures for one year. Budget funds are used to finance the operations, functions and programs of the Municipality, and for 2011 the Municipality planned 87.000 € as funds for studies, management of hydro power and other aspects of energy production, not including annual payment for electricity consumption of 60.000 €. Planned expenditure for infrastructure is 250.000 € including the electricity infrastructure.

Realization of the projects within the planned activities of the Sustainable Energy Action Plan could be achieved through Public Private Partnership (PPP). PPP occurs in different areas of public administration, in various forms, with different duration and with different intensity, and usually in cases where public administration is not able to directly perform public affairs.

There are significant sources for funding of the proposed measures and activities in the form of grants through various programs of the European Union, and these sources will significantly increase when Montenegro becomes a full member of the European Union, through Structural Funds. It will be necessary to ensure strengthening of human capacity in terms of special teams or office to monitor open tenders and prepare project proposals in accordance with guidelines. **Error! Reference source not found.** presents some of the funds and programmes of the EU, through which the planned activities of the Sustainable Energy Action Plan could be realized.

2.4.5 Planned Measures for Monitoring and Follow-Up

Continuous monitoring, control and reporting on the results are extremely important component of the implementation process of the SEAP of the Municipality of Kolašin. Monitoring of the dynamics and the successful implementation will be carried out by Project Management Team of the Municipality and their main tasks will be:

- to periodically check the realization of the proposed actions and
- to monitor the level of CO_2 emissions sector by sector and consequently to issue updates of the greenhouse gases emission inventory on regular basis. On two year basis the Municipality will submit an implementation report.

Table 2.1: Funds and Programmes of the EU

Instrument for Pre-Accession Assistance (IPA)	IPA is an instrument for pre-accession assistance for the period 2007-2013, for candidate and potential candidate countries. It is composed of five components: Assistance for transition and institution building; Cross-border cooperation (with EU Member States and other countries eligible for IPA); Regional development (transport, environment, regional and economic development); Human resources (strengthening human capital and combating exclusion); Rural development.
Cross-border cooperation Programmes (CBC)	Cross- border cooperation programmes are finances through second component of IPA fund. Montenegro is eligible to participate in the following programmes: - bilateral programmed, Montenegro-Albania - bilateral programme, Montenegro-Bosnia and Herzegovina - bilateral programme, Montenegro-Croatia - bilateral programme, Montenegro-Serbia - IPA Adriatic CBC Programme - South East Europe Programme - MED Programme
Competitiveness and Innovation Program (CIP)	Competitiveness and Innovation Program (CIP) is operationally divided into three programs of which the Intelligent Energy Europe (IEE) covers an area of environmental protection and energy efficiency. The main objectives of the IEE are as follows: increase energy efficiency and rational use of energy sources; promote new and renewable energy sources and encouraging diversity of energy sources and promote energy efficiency and use of new and renewable energy sources in transport.
Seventh Framework Program - FP7	Seventh Framework Program (FP7) is the main instrument of the European Union for funding scientific research and development, and activities include the organization of cooperation between universities, research centers and industry (including SMEs), and providing financial support for joint projects.
Concerto Program	Within FP7 is launched a special initiative called the Concerto, which has the main goal of encouraging local communities to implement activities to increase energy efficiency and renewable energy sources.
EU Structural Instruments	Structural instruments have the main goal to achieve economic and social cohesion and balanced development within the European Union through European Social Fund, European Fund for Regional Development and Cohesion Fund. Structural instruments have aim to reduce the differences between regions and create a better economic and social balance among member countries. Structural funds will be available to Montenegro and other candidate countries after their accession to the EU.
European Local Energy Assistance (ELENA)	Program ELENA was launched as cooperation between the European Commission and European Investment Bank in late 2009. The main source of funding ELENA comes from the Intelligent Energy Europe (IEE). Technical assistance will be provided to the cities and regions in developing energy efficiency projects and attracting additional investments, covering all types of technical assistance necessary for preparation, implementation and financing of the investment program.

3 BASELINE EMISSION INVENTORY

The Baseline Emission Inventory (BEI) quantifies energy flows and the amount of CO_2 emitted due to energy consumption in the territory of the Municipality of Kolašin in the baseline year, which serves as the reference against which the reduction targets and the actual achievements of individual actions and related emission reductions in 2020 shall be monitored and compared.

In order to avoid a large uncertainty in the BEI due to an unreliable data on energy consumption and need for CO_2 emission estimation, the first step in drafting the Sustainable Energy Action Plan was to choose a reference year. The main selection criterion was the availability of data required for calculation of CO_2 emissions, therefore as referent year was selected 2008, and the observed time frame of the Plan covered the period from 2008 until 2020.

The Baseline Emission Inventory of CO_2 is prepared according to the IPCC protocol. IPCC protocol for the determination of emission pollutants in the atmosphere is the protocol of the Intergovernmental Panel on Climate Change (IPCC) as the executive body of the Program for the Environment United Nations (United Nations Environment Program - UNEP) and World Meteorological Organization (WMO) in implementing the United Nations Framework Convention on Climate Change (UNFCCC).

The Baseline Emission Inventory (see Appendix B) contains data on energy production and consumption within the Municipality of Kolašin, and related CO_2 emissions, related to the two sectors:

- municipal buildings, equipment/facilities;
- tertiary (non municipal) buildings, equipment/facilities;
- residential buildings;
- municipal public lighting;
- industries (excluding industries involved in the EU Emission trading scheme – ETS) & Small and Medium Enterprises (SMEs)
- transport.

3.1 SOURCE OF DATA

The Baseline Emission Inventory preparation is very complex due to the difficulty in collecting homogeneous and complete data. In many cases there are no complete data regarding various energy sources and sectors or they are not presented with the same level of territorial or sectoral aggregation. Therefore, it is necessary to perform calculations and estimations based on indicators that use available information and allow estimation statistically based.

During the preparation it was used statistical source data from organization that have the institutional duty to perform surveys (Statistical Office of Montenegro- MONSTAT), but main data regarding energy consumptions were provided by Montenegrin Electric Enterprise-EPCG, through interviews and questionnaire filled in by representatives of this institution. Data were also assumed based on interviews with the municipal staff, the team's experience and reliable forecasts.

Since there is a lack of data used for the BEI preparation, many studies and analysis were used, as well as information made by other institutions. Table 3.1 shows institutions and documents which were used for data collection on renewable energy resources.

Table 3.1: BEI Data Sources

INSTITUTION	DOCUMENT NAME
Ministry for Economic Development (MED)	Strategy for the Development of Small Hydro Power Plants, Podgorica (2006)
Ministry for Economic Development (MED)	Whitebook, Energy Development Strategy of Montenegro by 2025, Podgorica (2007)
Ministry for Economic Development (MED)	Investing in the Energy Sector of Montenegro, Podgorica (2007)
Ministry for Economic Development (MED)	Renewable Energy Resources in Montenegro, Podgorica (2007)
Foundations for the Development of Northern Montenegro (FORS)	Socio-Economic Analysis of the Northern Region of Montenegro, Podgorica (2008)
Food and Agriculture Organization of the United Nation (FAO)	Grain Storage Techniques – Evolution and Trend in Developing Countries (2005)
Food and Agriculture Organization of the United Nation (FAO)	Forest and Forest Products Country Profile: Serbia and Montenegro, Geneva, Switzerland (2005)
Hydrometeorlogical Institute of the Republic of Montenegro (HIM)	Data Sets of Sunshine Hours (2006)
Centro di progettazione, design & tecnologie dei materiali (CETMA)	Renewable Energy Resource Assessment: Wind, Solar, Biomass Energy Assessment (2007)
Centro di progettazione, design & tecnologie dei materiali (CETMA)	Wind Atlas of Montenegro (WAM realized within Renewable Energy Resource Assessment of the Republic of Montenegro (2007)

The energy consumption for the transport sector was assessed considering data coming from different local sources:

- the traffic conditions of the Municipality were deducted from registered documents (European Agency for Reconstruction, 2003);
- the energy consumptions at national level were collected from the 2006 National Energy Strategy for Development;
- the emission factors for the vehicles and the heating values of the fuels were taken from the World Resources Institute (WRI) guide of the GHG Protocol (WRI, 2005);
- fuel sales at local fuel stations within the municipality were gathered through interviews;
- distances between locations were calculated during the surveys;
- other data were assumed based on interviews with the municipal staff, the team's experience and reliable forecasts.

3.2 ENERGY DEMAND AND GHG EMISSIONS

The current Section constitutes an attempt to assess all possible sources of greenhouse gas (GHG) emissions, which can be roughly attributed to:

- residential sector;
- tourism sector;
- public sector;

- industrial and commercial sector;
- transportation.

An overall analysis was carried out for every sector, though the accuracy of the collected data was different section by section, thus not allowing assessing all sectors with the same level of detail.

For the estimation of the GHG emissions, beside the specific carbon emission factors for each fossil fuel, **the GHG emission factor of the national electricity grid of Montenegro is used; its value has been calculated equal to 0.774 tCO_2/MWh**.

3.2.1 Residential Sector

The population of Kolašin is about 10,000 at present. It is envisaged that the total population of Kolašin remains constant between 2008 and 2020, which means the number of households in the Municipality remains 3,000 during the same period.

The most used energy sources for domestic needs are wood for space heating, and electricity. These two sources predominate, while the use of LPG, fuel oils and coal is substantially negligible.

The annual electricity consumption in the residential sector of Kolašin accounts for 13.4 GWh/yr between 2003 and 2005.[1] Currently, there are around 3,000 households in the Municipality of Kolašin. From data received by EPCG distribution, **the typical annual electricity consumption of one household is around 5.1 MWh/y in Kolašin**.

The annual electricity consumption in the residential sector can be divided into three categories, namely, hot water production, space heating, and obliged electric appliances (cooking, household appliances and lighting). Figure 3.1 illustrates the breakdown of the average electricity consumption in the residential sector of Kolašin.

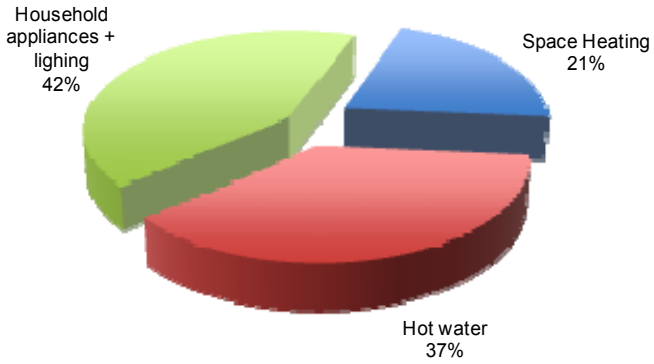


Figure 3.1: Breakdown of Electricity Consumption in Residential Sector in Kolašin

As shown in the above figure, it can be noticed that most of the electricity in the residential sector is consumed by household appliances and lighting, which accounts for nearly 42% of the total electricity consumption. The electricity consumption of households for lighting is about 0.5 MWh/y, which accounts for about 10% of total electricity consumption. On the

[1] Data were collected through a questionnaire filled in by EPCG staff and received on September, 9th, 2009.

other hand, the electricity consumption of domestic appliances accounts for 32% of the total electricity consumption in the residential sector, which is equivalent to 1.6 MWh/y for one household.

Hot water production accounts for 37% of the total electricity consumption in the residential sector, which is equivalent to 1.9 MWh/y for one household. Space heating contributes about 21% of the total electricity consumption, which is equivalent to about 1.1 MWh/y for one household.

The following sub-sections provide a tentative estimation of energy consumption in the residential sector of Kolašin during 2008.

3.2.1.1 Space Heating

Wood is the most used energy source for heating in the residential sector in Kolašin. Typically, houses have a stove installed in the most used room, the kitchen, sometimes the stove supplies heating to the neighboring rooms through a hot water radiator heating system, but in most cases the other rooms are not heated and there is a large use of electric heaters in bedrooms, bathrooms and other used rooms.

The following Table 3.2 indicates the main features of the residential buildings in the Municipality of Kolašin.

Table 3.2: Features of Residential Housing

Total Population	10,000
No. of residential buildings	3,000
Average surface of residential buildings	70 m^2
No. of inhabitants	3

Currently, two types of heating systems are used in the residential sector in the Municipality: a simple stove and a stove allowing heating of more rooms through radiators. Electricity is used for heating unheated rooms, especially in simple stove case. Through interviews with the municipal staff and thanks to the information on electric consumption provided by EPCG, it was possible to make a quantitative evaluation of energy consumption. The main data on individual household consumption are provided in the following Table 3.3.

Table 3.3: Heating System data in the Residential Sector

	Simple stove	**Stove with radiators**
Diffusion among homes	90%	10%
Energy Sources of heating system (thermal energy) - wood - electricity	 92% 8%	 100%
Annual average wood consumption	11 m^3/y	17 m^3/y
Average efficiency of the heating system	60%	60%
Energy Consumption	21,399 kWh/y	31,344 kWh/y

It was calculated that wood supplies about 92% of heating needs, the remaining being satisfied by electricity. The efficiency of the heating system in most of the houses is low. From wood and electricity consumption data, it was calculated that average yearly

consumption for heating a single household is around 290 kWh/m^2, a very high value in respect to the average European consumption, which is usually between 50 and 200 kWh/m^2. This is mainly due to the relatively low efficiency of common stoves and to the low insulation of buildings' envelope. This also indicates huge possibilities of improving the efficiency of the heating system in the residential sector.

The current energy consumption for space heating in Kolašin is about 67 GWh/y, of which 64 GWh/y from wood and 3 GWh/y from electricity. The total annual firewood consumption for heating is 34,800 m^3/y.

The following Figure 3.2 illustrates the energy distribution for heating system in the residential sector in Kolašin.

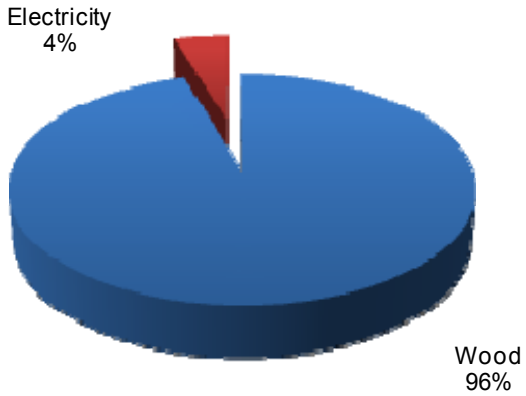


Figure 3.2: Breakdown of Energy Consumption for Household Heating Systems

The average annual registered firewood production within the Municipality was around 18,000 m^3/y between 2003 and 2007 in accordance with the national statistics, whereas the annual wood consumption for space heating in the residential sector coming from the average household consumption is about 34,800 m^3/y.

Furthermore, the overall annual GHG emissions for space heating in the residential sector of Kolašin can be estimated based on the annual consumption of electricity and wood for space heating. Nevertheless, the GHG emission factor for wood is considered neutral as wood is a biomass. The overall annual GHG emission estimate in the residential sector in Kolašin in 2008 amount to 2,300 tCO_2/y.

3.2.1.2 Hot Water Production

At present, electric boilers are used in nearly all the households of Kolašin for domestic hot water production, and are present in about 90% of the used dwellings. Some buildings are equipped with a centralized heating system running on wood, also providing hot water during the heating season. The current annual energy consumption for hot water production in the residential sector of Kolašin can be estimated at 6.3 GWh/y.

It is estimated that the current hot water consumption is about 30 liters/day per capita.

The consequent CO_2 emissions resulting from hot water production is equal to 4,900 t/year.

3.2.1.3 Electric Appliances

The typical domestic appliances used in the residential sector include fridge/freezer, washing machine, dishwashing machine, television, DVD/video player, HiFi, iron, electric oven, and microwave oven. Each appliance has different rated power and different operating hours throughout the year, therefore the energy consumption of each device is different.

The following Table 3.4 summarizes the percentage of diffusion among households of the most important appliances within the Municipality as well as the average annual energy consumption of one piece of equipment in Kolašin in 2008. The table is based on the consumption data of residential connections provided by EPCG, on interviews and on the team experience in the field.

The average energy consumption of appliances was evaluated based on appliances used in Italy in the late '90s, before a drastic increase of efficiency on the new main appliances following the introduction of energy labeling of the most energy consuming electric households.

This measure, which will also be suggested for Kolašin caused a drastic reduction of specific consumption of fridges, washing machines, dish washing machines and air conditioners in recent years.

Table 3.4: Energy Consumption and Distribution of Domestic Appliances in Kolašin

Appliance	Distribution %	Current Energy Consumption (kWh/y) [2]
Fridge/freezer	95%	578
Washing machine	70%	355
Dish washing machine	5%	569
Television	95%	249
DVD/video player	30%	208
HiFi	30%	196
Computer	10%	517
Iron	90%	190
Electric Oven	100%	227
Microwave Oven	5%	550

Based on the above diffusion rates of the domestic appliances, the average annual electricity consumption for domestic appliances for one household is estimated to be about 1.5 GWh/y in 2008. In the close future, the Government of Montenegro will introduce energy labeling for electric appliances on the same scheme used in the European Union, and this is likely to introduce similar changes. The law introducing energy labeling for electric appliances is already under preparation, and it is likely to be put in force by 2010-2011. The following Figure 3.3 illustrates a typical EU energy label for grade B washing machine.

[2] Annual Energy Consumption of a single piece under normal use.

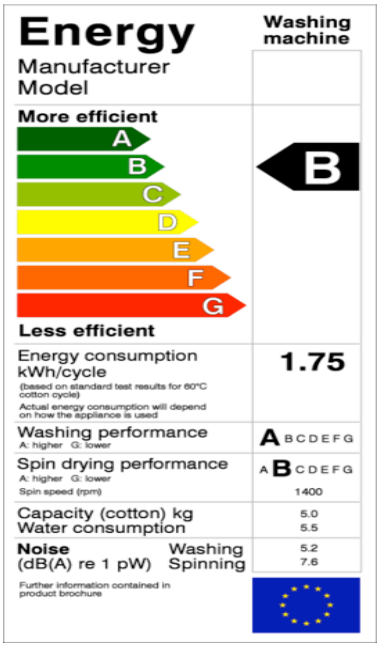


Figure 3.3: Energy Label of a Grade-B Washing Machine

The European Energy labeling scheme imposes the producers to provide the appliances with a label, indicating their yearly energy consumption (and some other characteristics dependant on the appliance), indicated in kWh/y and through an easily understandable scale going from A (lowest consumption) to G.

The average electricity consumption for domestic appliances for one household in Kolašin is about 1.6 MWh/y in 2008, corresponding to a total of 5 GWh/y for the entire Municipality.

3.2.1.4 Lighting

It was assumed that approximately 90% of the bulbs used in the residential sector of Kolašin are incandescence lamps, and the remaining are compact fluorescent lamps (CFL) or neon tubes.

By considering about 3,000 households located in Kolašin, the total electricity consumption for lighting in the residential sector within the Municipality is estimated to be 1.2 GWh/y in 2008.

In the past 10 years, fluorescent lamps came into market with progressively lower costs. Unlike traditional fluorescent tube, CFL is able to give off light similar to standard incandescence bulb.

In general, CFLs produce approximately a light 4 times higher than incandescence lamps of the same wattage; moreover the life span of the CFL is at least 8 times longer. The price of fluorescent lamps is higher than incandescence ones. However, because of their high efficiency and longer life span, the operating cost of CFLs is much lower.

For this reason, the gradual substitution of incandescent lamps with CFLs is something gradually happening in all countries even without putting in place any policy.

At the moment the overall annual GHG emission for residential lighting in Kolašin in 2008 was estimated in 906 tCO_2/y.

3.2.2 Tourism Sector

In the tourism sector, hotels and restaurants were considered. According to the Montenegro Statistical Yearbook 2008, there are currently 16 hotels and restaurants registered in the Municipality (MONSTAT, 2008). There are two major high class hotels located in Kolašin, namely, Bianca and Lipka. The other accommodations for tourists in the Municipality are mainly operated as bed and breakfast (B&B) and villas.

The overall electricity consumption in the tourism sector in Kolašin was about 2.57 GWh/y in 2008. In general, the average annual electricity consumption for a typical restaurant in the Municipality is around 18 MWh/y.[3]

The main energy sources in the hotels of Kolašin include electricity, mazut (heavy fuel oil), liquefied petroleum gas (LPG) and diesel. The total final energy consumption of hotels in Kolašin is around 5.5 GWh/y.

Mazut accounts for 60% of the overall final energy consumption in hotels in Kolašin, which is equivalent to about 3.3 GWh/y. Electricity consumption accounts for 37% of the total energy consumption of hotels, equivalent to 2.1 GWh/y. Small portion of energy is consumed by diesel and LPG in the hotels, which account for about 0.2% and 3%, respectively.

In general, mazut is mainly used for space heating and hot water production, whereas electricity is used for lighting, air-conditioning system and cooking. LPG is solely used for cooking at present. Currently, some of the hotels are planning to switch from mazut to LPG for space heating system.

Currently, there are about 50,000 tourists overnight stays in hotels in the Municipality in 2008, and it is expected that the tourism industry will grow exponentially thanks to the national development policy.

For the purposes of this study, only hot water production was considered for the prediction of energy consumption in the hotels of Kolašin during 2008. Currently, some of the hotels are planning to switch from mazut to LPG for hot water production. It is estimated that the annual renovation rate of hotels is about 5% in the Municipality.

The input parameters of hot water consumption in the tourism sector is summarized in the following Table 3.5.

Table 3.5: Input Parameters of Hot Water Production in the Tourism Sector

Parameter	Value
No of Tourists in 2008	50,000
Water Inlet temperature	5°C
Water Outlet temperature	50°C
Hot water consumption per tourist in 2008	80 l/day
Collectors daily operating hours	10 h/day
Efficiency of LPG boiler	90%
Efficiency of Mazut boiler	85%

[3] Data provided by EPCG during interviews and meetings held on May, 28th, 2009.

The annual thermal energy demand for hot water production in the tourism sector in Kolašin is about 0.2 GWh/y in 2008.

As shown in the above figure, the annual mazut consumption for hot water production in 2008 was 24,380 l/y in 2008. Based on the above figures an annual production of 686 tCO_2/y of GHG emission from mazut has been estimated.

3.2.3 Public Sector

The energy demand of the public sector of Kolašin includes energy consumption of public lighting, hospitals, schools, recreation centers, administrative buildings and court buildings. The final energy consumption of public sector includes electricity, wood, coals, diesel and natural gas.

The overall annual electricity demand of public sector is about 0.9 GWh/y, which accounts for about 4.6% of the overall electricity consumption in the Municipality of Kolašin. The following Figure 3.4 illustrates the breakdown of electricity consumption of the public sector in Kolašin.

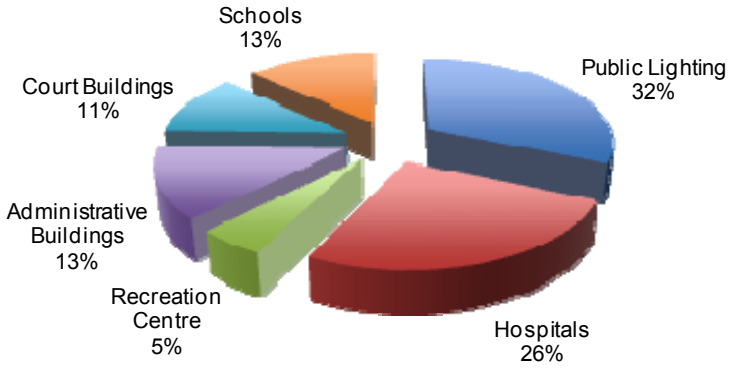


Figure 3.4: Breakdown of Electricity Demand in the Public Sector

Public lighting, which is also referred to as street lighting, is the largest electricity consumer in the public sector in Kolašin and it accounts for nearly 32% of the overall electricity consumption in the public sector. The annual electricity consumption of public lighting is about 0.29 GWh/y. Hospitals, administrative buildings and schools which account for about 26%, 13% and 13%, respectively.

3.2.3.1 Public Lighting

Currently, there are about 1,000 mercury vapor lamps for street lighting across the Municipality of Kolašin. It is assumed that all lamps for street lighting in the Municipality are the same, i.e. the same operating hours and the same rated power.

It is estimated that the daily operating period for street lighting is 12 hours in the winter and 8 hours in the summer. Table 3.6 summarizes the current performance of street lighting in Kolašin.

Table 3.6: Street Lighting Features in Kolašin

Parameter	Value
No. of lamps for street lighting	1,000
Types of lamp	Mercury Vapor Lamp
Annual Electricity Consumption	0.29 GWh/y
Annual Operating hours	3,650 h/y
Rated Power of each lamp	78 W

The electricity consumption for street lighting in Kolašin during 2008 is approximately 0.29 GWh/y; consequently the related GHG emissions are estimated in 221 tCO_2/y.

3.2.3.2 Schools

There are about 17 schools located across the Municipality of Kolašin, in accordance with the Montenegro Statistical Yearbook 2008. The final energy consumption of schools includes electricity, woods, coal, heavy fuel oil, and natural gas.

Most of the schools in the Municipality generally consume only wood, used for space heating, and electricity, used to cover all other energy demand including lighting, electrical appliances and hot water system. Few schools, especially secondary schools, utilize all energy sources as mentioned above. In general, heavy fuel oils, coals, and wood are used for space heating; natural gas and electricity also cover part of the heating demand. Natural gas is normally used to power the equipment in the workshop, while electricity is used for lighting and electrical appliances. Figure 3.5 illustrates the breakdown of energy consumption of schools in Kolašin in 2008.

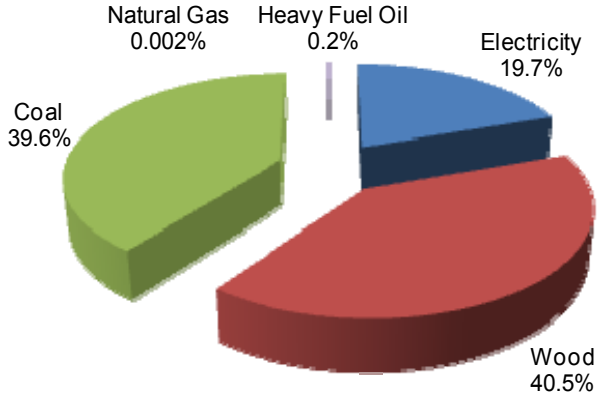


Figure 3.5: Breakdown of Energy Consumption of Schools (2008)

It is noted that most of the energy consumed in schools are mainly on wood and coal, which account for 40.5% and 39.6%, respectively. The consumption of electricity accounts for 19.7% of total energy consumption of schools in Kolašin. Both heavy fuel oil and natural gas contribute less than 0.3% of total final energy consumption in schools in Kolašin. There are about 1,028 students and 107 teachers in Kolašin at present (MONSTAT, 2008). As mentioned in Section 3.2.1, it is foreseen that population remains constant between 2008 and

2020. It is hence estimated that the total number of students and teachers in Kolašin will remains constant as well.

Therefore, annual energy consumption is calculated in 87 tCO_2/y for 2008.

3.2.4 Industry and Commercial Sector

In accordance with the Statistical Yearbook of Montenegro 2008, 38 manufacturing companies, 5 construction companies, 45 wholesale and retail trade companies, and 21 real estate companies were registered in the Municipality of Kolašin by the end of 2007 (MONSTAT, 2008). Currently, the average annual electricity consumption in the industrial and commercial sector of Kolašin is about 4.0 GWh/y[4]. It is foreseen that the overall energy consumption of the industrial and commercial sector will be increased due to the development of the tourism industry of the Municipality as more shops and related industries will be opened, and the operating hours could be extended. It was assumed that, according to current economic trends, the annual growth rate would be around 3%.

The annual GHG emissions of the commercial and industrial sector of Kolašin based on the annual electricity consumption is hence estimated in 3,087 tCO_2/y.

3.2.5 Transportation

The analysis of GHG emissions from transport, and of the related energy consumptions, is one of the most delicate issues in this study. Accurate data are needed for fuels, distances, means of transport, uses, etc. **This section mainly focuses on road transport, while airplanes and railway are not included within the study**. The first, because it was considered that people going by plane to Montenegro (Podgorica and Tivat airports) are not probably destined only to Kolašin, but the Municipality constitutes only a step in a wider trip and therefore the related consumptions and emissions should not be accounted for to the Municipality of Kolašin itself. Railway contribution was considered negligible due to the exiguous number of trips and of people using it; the eventual enhancement of national railway in the future would make necessary to consider as well the contribution of railway traffic. The balance of energy consumption for the transport sector was assessed considering data coming from different local sources:

- the traffic conditions of the Municipality were deducted from registered documents (EAR, 2003);
- the energy consumptions at national level were collected from the 2006 National Energy Strategy for Development;
- the emission factors for the vehicles and the heating values of the fuels were taken from the World Resources Institute (WRI) guide of the GHG Protocol (WRI, 2005);
- fuel sales at local fuel stations within the municipality were gathered through interviews;
- distances between locations were calculated during the surveys;
- other data were assumed based on interviews with the municipal staff, the team's experience and reliable forecasts.

A baseline scenario was identified considering the current traffic situation within the Municipality. At present, the privately owned car is the main mean of transport which is used to move from one place to another within the municipality and the town, and this is also the case for most of the access to the area from outside. Cars and, to a much lesser extent, taxi,

[4] Data were collected through a questionnaire filled in by EPCG staff and received on September, 9th, 2009.

therefore, are the mainstay of Kolašin mobility, both for residents and for tourists. Kolašin is located on the main road connecting Podgorica and Belgrade, served by a large number of long distance buses. These buses are an important alternative to car, and they are used both for intercity trips and for moving between Kolašin and the minor villages along the main road. Kolašin is characterized by low urban traffic conditions, i.e. reduced number of daily transfers, in accordance with the very low population density. The main actors in traffic are cars, buses and heavy trucks crossing the main road going towards Mojkovac and then Belgrade. Besides the typical daily traffic, a little contribution is due to the tourists reaching the Municipality's attractions, such as the National Park and the Ski Center. The purpose of this section of the study is the estimation of the contribution given by transportation to energy consumption and related GHG emissions. The GHG emissions typically consist of CO_2, N_2O and CH_4. According to international standards, since N_2O and CH_4 emissions comprise a relatively small proportion of overall transportation emissions, only CO_2 emissions are accounted for. All the following estimates are related to $kgCO_2$ equivalent (CO_2e), where CO_2e is a measuring unit which allows comparing, through standard conversion factors, the greenhouse effect produced by different gases compared to the greenhouse effect of CO_2, assumed as reference.

Following the approach suggested by the GHG Protocol, the emission factors (EF) for the means of transport and heating values for the fuels were combined in order to calculate the resulting CO_2e emissions. For buses, where data on fuel consumption were available, the emissions were calculated following the "Fuel-based method", which consists in multiplying the EF of each fuel ($kgCO_2e/l$) for the amount of fuel used. In all the other situations, the "Distance-based method" was applied, consisting in multiplying the EF of the fuels ($kgCO_2e/km$) for the distance traveled by each vehicle. In the Table 3.7 the values used for the calculation suggested by the abovementioned methodology are illustrated.

Table 3.7: Data Assumptions for Transport GHG Emissions

Data	Value	Unit
Emission factor car	0.233	$kgCO_2/km$
Emission factor medium van	0.311	$kgCO_2/km$
Emission factor large van	0.400	$kgCO_2/km$
Emission factor train	0.06	$kgCO_2/km/capita$
Emission factor light truck	0.374	$kgCO_2/km$
Emission factor heavy truck	0.87	$kgCO_2/km$
Emission factor bus	1.035	$kgCO_2/km$
Emission factor petrol/gasoline	69.25	$kgCO_2/GJ$
Emission factor diesel	74.01	$kgCO_2/GJ$
Heating value gasoline	0.0344	GJ/l
Heating value	0.0371	GJ/l
Share of gasoline	42	%
Share of diesel	58	%
Distance Mioska-Kolašin	20	km
Distance Kolašin-Mojkovac	37	km
Distance Kolašin-Matesevo	12	km
Yearly diesel consumption for buses	3,974,400	l/y
Conversion factor GJ/GWh	0.000278	GWh/GJ

3.2.5.1 Road Transport

The estimation on the traffic conditions for Kolašin was carried out considering data collections from surveys provided in a dedicated study by EAR (2003). An analysis on car passages for the Municipality was performed measuring the annual average daily vehicular traffic along the three main roads Mioska-Kolašin, Kolašin-Mojkovac and Kolašin-Matesevo.

These very accurate data were used to estimate a projection on the current traffic conditions, combining them with data from the national inventory. The study contained data on the annual fuel consumption for road transport for the overall Montenegro and forecast for the annual average vehicular traffic for year 2010; the national inventory contained data on the annual energy consumption for road transport and it was possible to convert them into fuel consumption, according to the share of diesel and gasoline presented in Table 3.7. In this way, a comparison between the forecasts and the real situation has been produced, thus obtaining a coefficient which allowed projecting the specific data sample for the three Kolašin roads to the current year. This coefficient is the ratio between the real data and Luis Berger's forecasts, equal to 1.49. Applying this coefficient to the sample, the annual average daily vehicular traffic for the current situation was estimated for the three roads.

According to the available data and to the assumptions, the estimation of energy consumption and CO_2e emissions was possible considering the various contributions given to road traffic by internal traffic, buses, heavy trucks, tourist transportation.

For the vehicular traffic related to cars, vans, trucks and buses, it was possible to estimate the annual average daily traffic conditions along the three main extra-urban roads connecting Kolašin with the rest of the Country, properly combining data sampling with the energy consumption of the national strategy. The main roads considered for the sampling were:

- Podgorica – Kolašin (limited to the route Mioska – Kolašin);
- Kolašin – Mojkovac;
- Kolašin – Matesevo.

This estimation allowed to calculate total the net GHG emissions (i.e.: not including the contribution of buses, trucks, urban transport and tourists transport contributions, which have been separately analyzed) equal to 27,712 tCO_2e/y.

These data illustrated that cars are the most common vehicles, around 60%, but also trucks are very common, being 28% on the total.

3.2.5.2 Buses

The estimation made for the buses is based on the national statistical data for road transportation: getting from statistics the national amount of "passenger-kilometer" and the national "kilometer traveled", data were projected at local scale considering the ratio between the population of Kolašin and the population of the Country. Then, it was possible to evaluate the fuel consumption for Kolašin dividing the km traveled for the average fuel consumption for buses. Eventually, the fuel consumption was split into diesel and gasoline according to the % illustrated in Table 3.7. Once obtained the fuel consumption, the yearly CO_2e emissions were calculated through the "fuel-based" approach. This approach allowed calculating overall emissions equal to 295 tCO_2e/y. The assumptions and the figures of the calculation are enclosed in the following Table 3.8.

Table 3.8: Annual GHG Emissions for Buses

Data	Value	Unit
National Population	620,145	
Kolašin Population	9,949	
national passengers-km	146,000,000	
local passengers-km	2,342,281	
national km travelled	17,720,000	km/y
Kolašin km travelled	284,282	km/y
average fuel consumption	2.5	l/km
liters of fuel Kolašin	113,713	l/y
liters gasoline	47,759	l/y
liters diesel	65,954	l/y
emissions diesel	**181,093**	kgCO_2e/y
emissions gasoline	**113,773**	kgCO_2e/y

3.2.5.3 Trucks

The same approach used for buses was adopted for the estimation of the emissions related to trucks. The relevant data in this case were "ton-kilometer" and "kilometer traveled". This approach allowed calculating overall emissions equal to 403 tCO_2e/y. The assumptions and the figures of the calculation are enclosed in the following Table 3.9.

The approach followed for trucks and buses allowed separating the emissions related to Kolašin from the ones due to vehicles in transit. In the overall calculation, these contributions were therefore deducted from the "Road Transport emissions".

Table 3.9: Annual GHG Emissions for Trucks

Data	Value	Unit
national ton-km	137,058,000	
local ton-km	2,198,825	
national km travelled	24,240,810	km/y
Kolašin km travelled	388,896	km/y
avg fuel consumption	2.5	l/km
liters of fuel Kolašin	155,558	l/y
liters gasoline	65,335	l/y
liters diesel	90,224	l/y
emissions diesel	**247,734**	kgCO_2e/y
emissions gasoline	**155,640**	kgCO_2e/y

3.2.5.4 Urban Transport

Another sector considered is the urban transport. Everyday local inhabitants have to move inside the Municipality for everyday's occupations: work, shopping, etc. A high number of trips take place for small routes all the yearlong; considering an average number of 1,500 trips per day, of which 90% by car and 10% by motorcycle, and an average route of 15 km per round trip, every year the urban transport is responsible for 1,800 tCO_2e.

3.2.5.5 Tourists Transport

The last category responsible for energy consumption and CO_2 emissions is tourism. Currently, the impact of tourism on traffic is still low since the annual number of presences in Kolašin is under 30,000 overnight stays (see Table 3.10– MONSTAT, 2008), so it is probable that the total number of tourists could be double, considering other forms of stay (residential houses, room rentals, etc.). They are mainly weekend tourists, but the estimated future scenarios say that an increase in the number of presences is expected by 10 years. This will impact, besides the urban development and the infrastructure system of the town, also on the environment with an increase of the GHG emissions. The current situation was assessed considering the two seasons, summer and winter, each of them further divided into urban and extra-urban; the second subdivision aims at distinguishing the trip to reach and leave the area of Kolašin and the local transport inside the Municipality, from the hotels/houses to the tourist attractions. It was estimated a different share of tourist presences in Kolašin for summer and winter: based on the annual amount of overnight stays provided by the national statistics, it was considered that 60% of them will be summer tourists and 40% are winter tourists, thus corresponding to 13,065 people in summer and 9,070 people in winter. It was calculated that the average stay of tourists within Kolašin is around 2.5 days. This value was considered both for summer and winter season.

The assumptions for the calculation of the tourist impact on CO_2 emissions are summarized in the following Table 3.10. It must be noted that the following data are slightly different for the winter scenario, as illustrated below in this section. It was assumed that the average distance traveled to reach Kolašin is 80 km. The modal mix for extra-urban transportation was assumed to be 25% by bus and 75% by car. The consumptions and the related emissions for the extra-urban transport can be accounted, therefore, only for the going and the return trip, but not for the days of stay in Kolašin. Based on current statistics (MONSTAT, 2008) and on the "Distance-based" approach, the trend shows that for the whole season they will be responsible for 69 tCO_2e in summer and 46 tCO_2e in winter.

Table 3.10: Data Assumptions for Tourist Traffic Emissions

Data	Value	Unit
total number of tourists – in hotel	28,344	people
total number of tourists – other	28,344	people
summer share	60%	%
winter share	40%	%
average night stay	2.5	night/capita
average nr of people	22,675	people
summer tourists	13,065	people
winter tourists	9,070	people
average route	80	km
share of people by car	75	%
share of people by bus	25	%
car occupation	3	people/car
bus occupation	50	people/bus

Once they are in Kolašin, in summer, tourists have to get to the points of interest, moving either by car/bus or by foot/bicycle. A share of 50% of them will use private car (3 people/car) to get to their destinations (National Park, Komovi, Lipovo, etc.) with an average route of 10 km each. Using the "Distance-Based" approach, it was calculated that they are responsible for 10 tCO_2e emissions every year.

During winter season, it is estimated that tourists mostly move to the ski center Jezerine (90%) which is located 10 km far from the town, while 10% of them is not using a mean of transport. The main assumption for winter local transport is the use of private cars for 60% of the tourist, with an average occupation of 3 people per car, and of minibuses for 20 people each for the remaining 40%; according to the same "distance-based" calculation as for the other categories, they will be responsible for 10 tCO_2e emissions every year.

3.2.5.6 Outcomes

The assessment revealed that the main consumptions come from road transport, above all trucks and buses, which are responsible for more than 60% of the emissions.

It must be noted that the "Road Transport" is largely influenced by cars and trucks in transit most of which are not destined to Kolašin itself but to further destinations. Since this contribution is not related to the municipal policies for sustainable mobility, Road Transport is to be considered not directly responsible of GHG emissions for the Municipality of Kolašin.

Therefore, in the current scenario, the amount of emissions accountable for Kolašin should not include all the contribution of the "Road Transport" but only buses, trucks, urban transport and the tourist transportation.

In the Table 3.11, the results of the estimations are illustrated, also including the figures for the road transport. However, as highlighted above, for the energy balance of the Municipality of Kolašin only buses, trucks, urban and tourist transport shall be taken into account and those are the values considered for the diagrams presented below (see Figure 3.6).

Table 3.11: GHG Emissions for Vehicular Traffic (2009)

Mean	Emissions	Unit
Road Transport	27,712	tCO_2e/y
Buses	295	tCO_2e/y
Trucks	403	tCO_2e/y
Urban Transport	1,799	tCO_2e/y
Tourists	137	tCO_2e/y

The results of the estimation show that vehicular transport for the Municipality of Kolašin can be considered responsible of 2,634 tCO_2e/y. The contribution given by the tourist traffic on the municipal GHG emissions is quite low at the moment, around 5% on annual average.

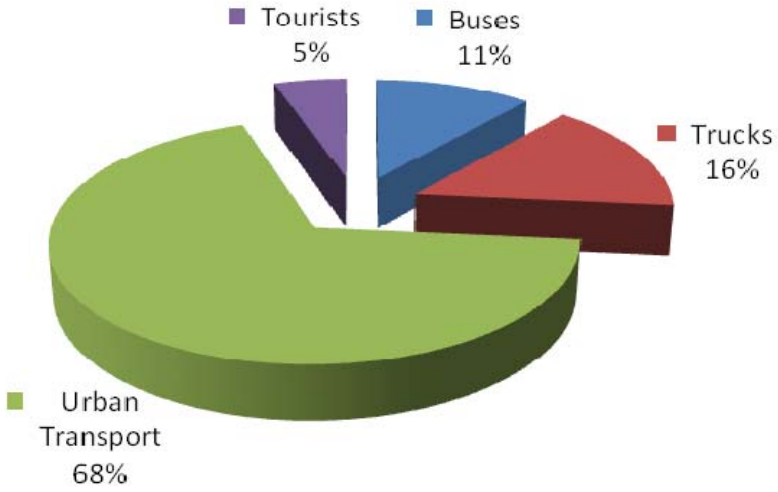


Figure 3.6: Influence of Means of Transport on CO_2e Emissions (2009)

According to the above calculations, the associated energy consumptions were also calculated. In the current situation, the value of CO_2e tons can be converted into GJ or GWh of equivalent energy, through bottom up calculation and appropriate conversion factors (from $kgCO_2e$ to GJ).

Using the emission factors for gasoline and diesel and the conversion factor from GJ to GWh, the total amount of CO_2e emissions for Kolašin was converted into GWh of energy consumed and in liters of equivalent fuel.

The result of the estimation on the CO_2 emissions led to calculate an equivalent energy consumption of 10.2 GWh/y for the current situation.

The same approach also allowed estimating the fuel consumption corresponding to those emissions: according to the assumed emission factors, heating values and share of diesel and gasoline from (see Table 3.7), an annual consumption of 607,500 l of gasoline and 777,900 l of diesel was calculated.

These results are related, as illustrated above, to the sole consumption related to Kolašin, and do not include the cars in transit, which are responsible of higher emissions (and consumptions) but cannot be directly assigned to the Municipality.

3.3 BASELINE EMISSION INVENTORY RESULTS

The baseline emissions of Montenegro in year 2008 have been estimated using the Greenhouse gas (GHG) emission factor of electricity system in Montenegro estimated in accordance with the methodological tools "Tool to calculate the emission factor for an electricity system," adopted from United Nations Conventions for Climate Change (UNFCCC).

The GHG emission factor is determined based on the displacement of electricity generated by power plants in an electricity using combined margin emission factor of the electricity system.

The existing power plants and their specifications that are used for estimating the GHG emission factor of the electricity of Montenegro are summarized in the Table 3.12.

The value of the annual fuel consumption and power generation are the average of the following three consecutive years: 2006, 2007 and 2008. Data concerning annual fuel consumptions were calculated based on an efficiency value (28.3%). This value has been considered constant for the three years.

Data on annual power generation for years 2006, 2007 and 2008 was found in the yearly Report on Business Operations developed by EPCG; specifically:

- Report on Business Operations of Montenegrin Electric Enterprise – Nikšić, for year 2006 (dated May 2007);
- Report on Business Operations of Electric Power Industry of Montenegro – Joint Stock Company Nikšić, for year 2007 (dated May 2008);
- Report on Business Operations of Elektroprivreda Crne Gore A.D. Nikšić, for year 2008 (dated May 2009).

Table 3.12: National Energy Production and Supply Data – Year 2008

Power plants	Installed Capacity (MW)	Fuels and annual consumption	Annual power generation (GWh/y)	Fuels emission factor (tCO2/GWh)
TPP Pljevlja	210	Lignite : 12,709 TJ/y	999.1	363.6
HPP Piva	344	Water	681.9	-
HPP Perucicia	307	Water	817.5	-
Other SHPPs	9	Water	18.2	-
Import			3,033.2	-

Based on the above table, it was found that the average GHG emission factor for electricity system in Montenegro is 0.774 tCO_2/MWh. In the **Error! Reference source not found.** the annual energy consumption and the related GHG emissions for each sector above described are summarized; the Baseline Emission Inventory developed according to the SEAP template is presented in Appendix B.

As shown in the **Error! Reference source not found.** the Municipality of Kolašin used 42,470 MWh in 2008 with an equivalent GHG emission volume of 20,987 tCO_2; the large majority of the energy (64%) was supplied by biomass mainly used for domestic heating and by the electric power which is largely used (22.5%) in all the sectors as showed in Figure 3.7.

It must also be noted that all the demand of the transport sector is satisfied by fossil fuels (diesel and gasoline) as well as little part of the heating energy demand which is fulfilled by heating oil.

Table 3.13: Baseline Energy Consumption and GHG Emissions – Year 2008

Category	Energy Consumption [MWh/y]							GHG Emission [tCO_{2eq}/y]
	Electric Energy	Liquid Gas	Heating Oil	Diesel	Gasoline	Biomass	Sector Total	
Residential	15,500	-	-	-	-	64,000	**79,500**	11,971
Tourism	2,100	100	3,300	-	-	-	**5,500**	2,599
Public	900	-	-	-	-	-	**900**	696
Industry & commercial	4,000	-	-	-	-	-	**4,000**	3,087
Transport	-	-	-	5,900	4,270	-	**10,170**	2,634
Sub-total	*22,510*	*100*	*3,300*	*5,900*	*4,270*	*64,000*	**-**	
TOTAL	**42,470**							**20,987**

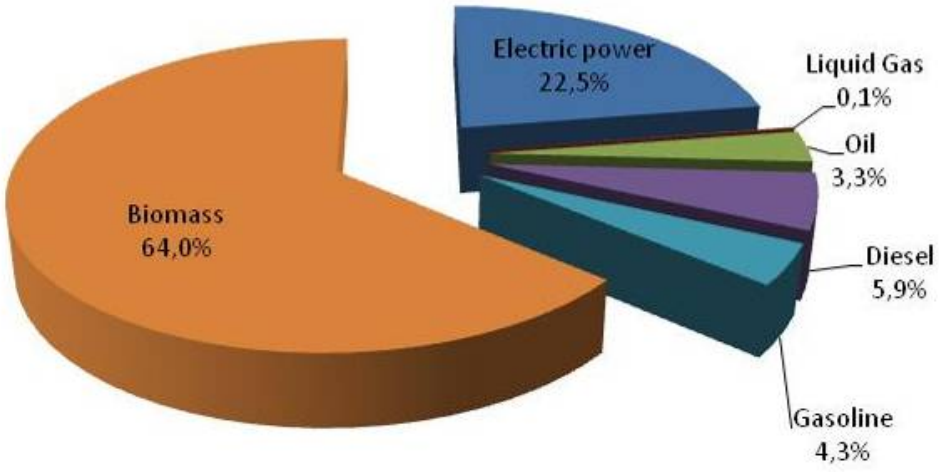


Figure 3.7: Energy Sources Contribution to the Baseline Scenario –Year 2008

As shown in Figure 3.8 the residential sector is the main energy consumer accounting for approximately the 80% of the total demand; while the transport related energy demand, 10% of the total requires the same energy as the industrial & commercial (4%) and tourism (5.5%) sectors together. In Figure 3.9 are presented the sectors contributions to the overall GHG emissions of the Municipality; it must be noted that even if the residential sector remains the main contributor, its percentage drastically reduces of more than 20% since the needed energy is mostly supplied by biomass and electric power; the residential sector percentual decrease is absorbed by industry and commercial sector contribution (14.7%) as

well as the tourism one (12.4%) due to the utilization of electric power and fossil fuels for energy purposes.

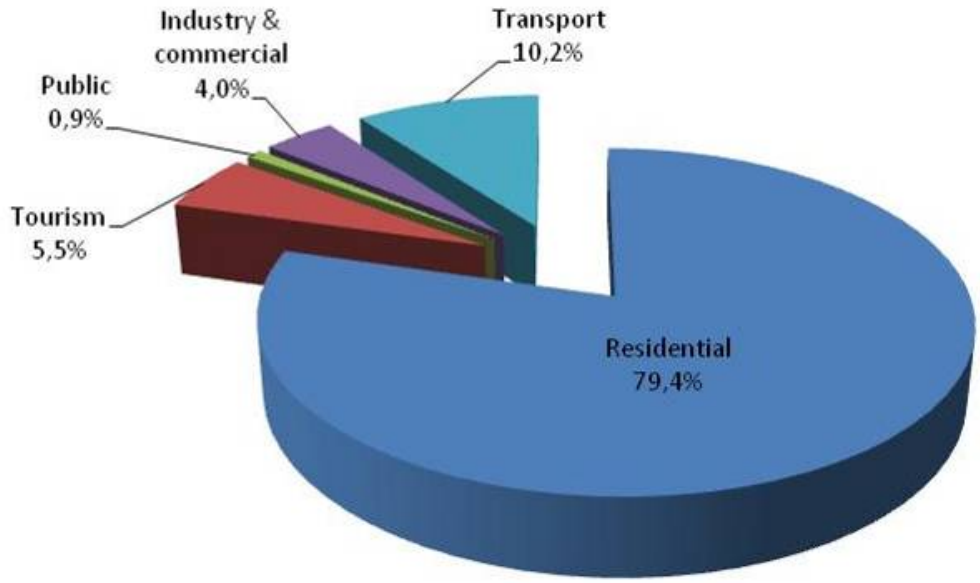


Figure 3.8: Final Uses of Energy – Year 2008

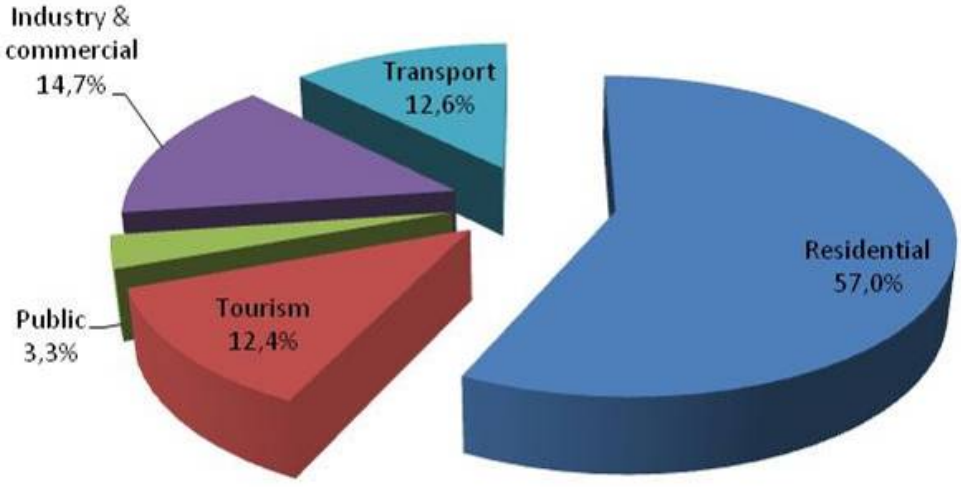


Figure 3.9: GHG Emissions by Sector – Year 2008

4 THE PLANNED ACTIONS AND MEASURES

In this section are described the actions planned in order to meet the objectives and emissions reduction target set for each sector outlined in Section 2.3; the description of the actions provide an estimation of the resulting CO_2 emissions reduction at municipal level, the timeframe for implementation until the 2020 and the body responsible for their implementation is the Municipality of Kolašin.

The Action Plan summarized according to the SEAP template is presented in Appendix C.

Increase of energy efficiency in end uses will represent a key pillar for the sustainable energy development of Kolašin. In the residential sector buildings shall be better insulated and less dependent by electricity both for hot water production and heating. Moreover, the reduction of electricity bills could be reached through a gradual replacement of the low efficient electric appliances currently used. In the public sector, a possible action is proposed on street lighting. New policies are suggested for transportation, enhancing the use of public services and promoting LPG as fuel for private cars. It is proposed efficient use of renewable resource potential building new small hydro power plants and wind farms.

4.1 RESIDENTIAL SECTOR

The actions presented are focused on the residential sector with the purpose of further enhancement of the overall energy efficiency level and promoting rational energy consumption in households. The proposed actions will significantly reduce the consumption in the residential buildings, allowing the citizens to reach energy and financial savings.

For the implementation of the proposed actions is fundamental an initial information and awareness raising campaign at municipal level, aimed at highlighting financial benefits guaranteed by energy efficient domestic products including domestic appliances and lighting.

4.1.1 Use of Solar Energy for Heat Production in Residential buildings

Currently, the solar energy is not utilized in the Municipality. Solar energy for preparing domestic hot water is generally one of the easiest methods of utilization of this energy. At present, hot water heating in the residential sector of Kolašin is mainly generated from electric boilers. It is expected that in the next years domestic hot water consumption will increase significantly as the standards of living are improved. Hot water production in the residential sector in the Municipality has thus a huge potential for solar energy applications.

One of the scopes of this part of the SEAP is to promote and disseminate the use of the solar thermal technology. Therefore, it is necessary to gradually create a demand and to form, through dedicated training courses, skilled technicians able to satisfy the demand.

Since, in general, the life span of a building is between 35-50 years, it is expected that approximate 3% of the population would renovated their home annually.

In the Kolašin residential sector, hot water is mainly generated by electric boilers. A measure of solar thermal hot water system is hence proposed in the residential sector of the Municipality. It is foreseen that investment subsidies for solar systems in residential sector will be introduced in Kolašin in 2012, with total amount of 178,000 EUR until 2020 paid by the Municipality.

Based on the above factors, it is foreseen that the installation of solar thermal system in the residential sector of Kolašin is divided in the following pattern between 2010 and 2020.

- 2010-2011 (2 years): no solar thermal system will be installed in the Municipality;
- 2012-2014 (3 years): on 20% of the renovated building solar thermal system will be installed annually, thanks to the introduction of the financial incentives;
- 2015-2020 (6 years): on 75% of the renovated building solar thermal system will be installed annually, due to both the financial incentives and further promotion from the government.

The input parameters for the assessment of the proposed measures are summarized in the table Table 4.1:

Table 4.1: Hot Water Consumption in the Residential Sector

Parameter	Value
No. of inhabitants	10,000
Water Inlet temperature	5 °C
Water Outlet temperature	50 °C
Hot water consumption per person in 2008	30 l/day
Hot water consumption per person in 2020	40 l/day
Collectors daily operating hours	10 h/day

Based on the above data, the thermal energy demand for hot water is increasing in parallel with the hot water demand: the total annual thermal energy demand in Kolašin in the residential sector is about 5.7 GWh/y in 2008, and it is expected to reach about 7.6 GWh/y by the end of 2020. The overall thermal energy for hot water production from solar energy is expected to be 90 MWh/y by the end of 2014, whereas the remaining 6.6 GWh/y still rely on electricity.

It is foreseen that more solar thermal system will be installed in the residential sector after year 2015, with the annual installation rate of 75% of renovated residential building. It is expected that about 15.3% of the residential building will be equipped with solar thermal system: more thermal energy from hot water production will be achieved from solar energy between 2015 and 2020 (see Figure 4.1), with about 876 MWh/y of thermal energy for hot water production satisfied by solar thermal system by the end of 2020.

In Kolašin, nearly all the hot water is currently generated from electric boilers. The corresponding electricity demand for hot water generation is hence determined based on the efficiency of the electric boilers as listed in Table 4.2.

Table 4.2: Electric Boilers Efficiency and GHG Emission Factor

Parameter	Value
Electric Boiler Efficiency	90%
GHG Emission Factor of Montenegrin grid	0.774 tCO_2/MWh

Figure 4.1 illustrates the corresponding annual electricity saving from solar thermal systems in the residential sector as well as the estimated corresponding GHG emission reduction in Kolašin between 2008 and 2020.

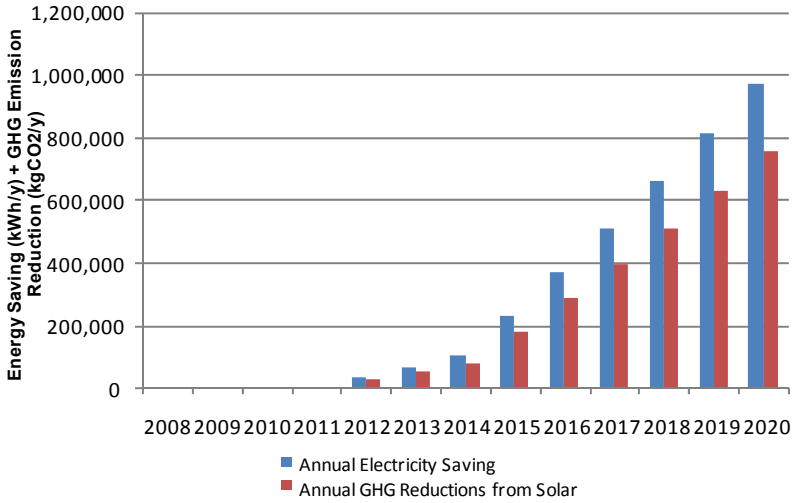


Figure 4.1: Electricity Saving from Solar Thermal Hot Water Production in the Residential Sector

As shown in the above diagram, the annual electricity saving from installation of solar hot water system is increasing with time. It is noted that if solar thermal systems are installed in the residential sector in Kolašin in accordance with the planned installation rate, the corresponding total annual electricity reduction is estimated to be 974 MWh/y by the end of 2020. The reduction is accounts for about 11.5% of the total electricity demand for hot water production.

Furthermore, by taking into account the GHG emission factor of the electric grid in Montenegro is 0.774 tCO_2/MWh, it is expected an overall annual GHG emission reduction from solar thermal systems in the residential sector in Kolašin of the order of 753 tCO_2/y by the end of 2020. The Table 4.3 summarizes the GHG emission of hot water production in the residential sector of Kolašin in 2020.

Table 4.3: GHG Emissions for Hot Water Production in the Residential Sector

Scenario (2020)	Annual GHG Emissions (tCO_2/y)
Predicted scenario	6,569 tCO_2/y
Proposed Measures	5,816 tCO_2/y

Based on the above data, the total solar thermal collectors' area is estimated to be 1,780 m^2 by the end of 2020, in order to supply hot water for 11.7% of the total population in the Municipality. Approximately, 183 m^2 of solar collectors will be installed by the end of 2014 and it will increase to 260 m^2 between 2015 and 2020.

4.1.2 Use of High Efficiency Electric Equipment in Residential Buildings

4.1.2.1 Domestic Appliances

It is expected that about 50% of the population will switch to domestic appliance with energy label of Grade A+ in accordance with the EU standard by the end of 2020. Nevertheless,

according to the EU directives (Commission Directive 2003/66/EC, Commission Directive 1999/9/EC, and Commission Directive 96/89/EC) only fridge/freezer, washing machine, and dish washing have energy label of Grade A+. Based on the above factors, the installation of Grade A+ domestic appliances in the residential sector in Kolašin should develop according to the following pattern:

- 2010 (1 year): no Grade A+ / Grade B domestic appliances will be installed in the municipality;
- 2011 (1 year): installation of Grade A+ in some households will start thanks to the energy efficiency information and awareness raising campaign;
- 2012 - 2020 (9 years): installation of Grade B domestic appliances in part of the households will start and at the same times Grade A+ electrical devices will continue to be introduced in households. By the end of 2020, it is estimated that 50% of the households will have Grade A+ appliances and the remaining 50% will have Grade B appliances.

The average annual installation rate for Grade A+ appliances is about 8% and the average annual installation rate for Grade B is about 9%.

Figure 4.2 illustrates the overall electricity consumption for domestic appliances for one household in accordance with the baseline scenario and the proposed measures between 2008 and 2020.

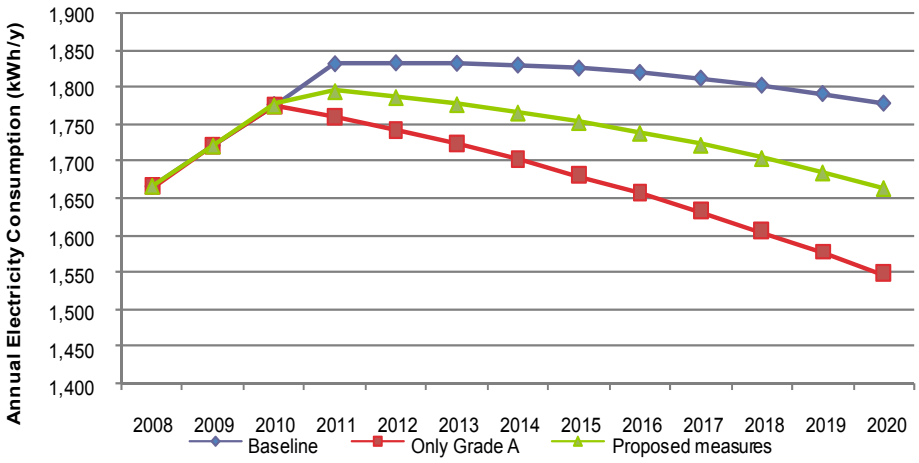


Figure 4.2: Electricity Consumption for Domestic Appliances in 1 Household (2008 – 2020)

As mentioned before, it is expected that part of the population will start replacing Grade A+ appliances by 2011 after they will be convinced on the financial and environmental benefits through the energy efficiency campaign initiated in 2010. It is seen that the average annual electricity consumption for domestic appliances for one residential dwelling starts decreasing from 2012, regardless of the increase in ownership rate of domestic appliances within the Municipality.

On this basis, the annual electricity consumption for domestic appliances for one household is expected to decrease from 1.83 MWh/y in 2012 to 1.78 MWh/y in 2020 in the predicted scenario (baseline), and from 1.8 MWh/y in 2011 to 1.66 MWh/y in 2020 in accordance with the proposed measures. This means that the total annual electricity consumption for domestic

appliances in Kolašin is about 5.3 GWh/y for the baseline scenario and 5.0 GWh/y for the proposed measures in 2020, by considering that the total number of household will remain equal to 3,000 by the end of 2020. Therefore, approximately 0.3 GWh/y of electricity could be saved by the end of 2020.

Table 4.4 summarizes the annual GHG emissions for domestic appliances by the end of 2020 with and without the implementation of the proposed actions.

Table 4.4: GHG Emissions for Domestic Appliances

Scenario (2020)	Annual GHG emissions (tCO_2/y)
Predicted scenario	4,126 tCO_2/y
Proposed Measures	3,860 tCO_2/y

4.1.2.2 Residential Lighting

It is expected that most of the inhabitants in the Municipality will be highly interested in switching from the traditional incandescence lamps to CFL after they understood their financial and environmental benefits. It was estimated that about 90% of the electricity consumption for residential lighting in Kolašin will be due to CFL by the end of 2014.

Figure 4.3 illustrates the overall electricity consumption for lighting for one household in accordance with the baseline scenario and the proposed measures between 2008 and 2020.

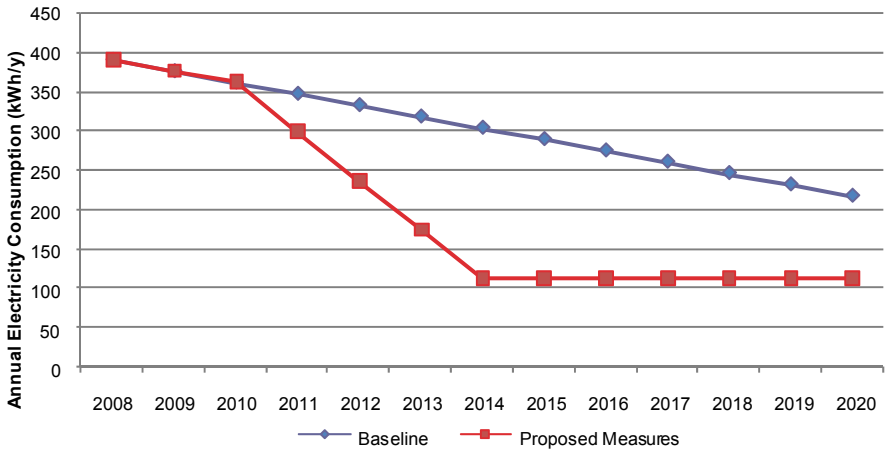


Figure 4.3: Electricity Consumption for Lighting in 1 Household (2008 – 2020)

As shown in the above figure, the average annual electricity consumption for lighting for one household is declining since 2008, as more households will be gradually replacing conventional incandescence lamp by CFL. On this basis, the average annual electricity consumption for lighting could be about 347 kWh/y for one household by the end of 2010, which is equivalent to 1.04 GWh/y for the entire residential sector of Kolašin by considering about 3,000 households in the Municipality.

By comparing the expected overall electricity consumption for domestic lighting for one household on baseline and proposed measures scenarios in 2020, it is found that the average annual electricity consumption for lighting in one household is about 217 kWh/y for the baseline scenario and 113 kWh/y for the proposed measures scenario. This means

approximately 0.65 GWh/y for the baseline scenario and 0.34 GWh/y for the proposed measures scenario in the entire residential sector of Kolašin.

For the proposed measures, the additional annual GHG emission reduction between 2008 and 2010 will be about 11 $kgCO_2/y$, and it is expected to increase to 48 $kgCO_2/y$ between 2011 and 2014 for one residential dwelling after the energy efficiency campaign. The annual GHG emission reduction with respect to 2008 level for the proposed measures will reach 215 $kgCO_2/y$ per household from 2014 to 2020.

Considering a total of 3,000 households in the Municipality, the overall GHG emissions for household lighting in Kolašin by the end of 2020 is summarized in Table 4.5.

Table 4.5: GHG Emissions for Household Lighting

Scenario (2020)	Annual GHG Emissions (tCO_2/y)
Predicted scenario	502 tCO_2/y
Proposed Measures	261 tCO_2/y

In the following it is analyzed the cost effectiveness of replacing traditional light bulb by energy efficient light bulbs. The financial benefits are evaluated on a 10 years period, as summarizes in the Table 4.6. Several assumption were taken into account, including the daily operating hours of lighting in the residential sector (6 h/day) and the electricity price (0.1 EUR/kWh).

Table 4.6: Financial Assessment of Lamps Replacement

Lighting	Incandescence Lamp	CFL
Rated Power *	60 W	11 W
Annual electricity consumption	131 kWh/y	24 kWh/y
Electricity cost for 10 years	131 EUR	24 EUR
Price of bulb	0.5 EUR	5 EUR
Life span of bulb	1,000 h	8,000 h
No. of bulbs used in 10 years	22	3
Cost of bulbs in 10 years	11 EUR	15 EUR
Total Cost in 10 years	**142 EUR**	**39 EUR**

Remark: for same lumen (light intensity)

As outlined in the above table, it is seen that about 103 EUR would be saved in 10 years for replacing one incandescence lamp by CFL. Assume that if 10 light bulbs are used in one domestic dwelling, approximately 1,030 EUR could be saved on a 10 years period in one individual household.

4.1.3 Increase of Heating Efficiency in Residential Buildings

The most effective measure in terms of reduction of energy consumption and improvement, at the same time, of internal comfort, is not much related to energy sources but to reduction of energy demand, thanks to a better insulation of roofs, facades, basement and to an improvement of performance of glazed structures, proven capacities in the field of low energy consumption buildings. Due to the reduced renovation rate of buildings, the effects of this policy are slow, but they are structural. It is estimated that about 3% of the existing building stock is renewed annually.

The present action is mostly related to the development of the technical capabilities and of the market for building efficient houses, a very good example of high efficiency building is already provided by the Regional Tourist Office.

Due to the entangling between energy efficiency aspects (reduction of losses) and the introduction of more efficient wood fuelled plants, two actions that is assumed to pursue contemporaneously, the results of the two actions are considered together.

Table 4.7 outlines the features of the future residential housing, both for smartly renewed houses and for new ones.

Table 4.7: Data on Energy Demand in Renovated Residential Buildings

Parameter	Value
Specific energy demand	50 kWh/m^2
Heating System energy efficiency	85%
Average area	100 m^2

It is calculated that the total annual heating energy need for one household is of about 5,900 kWh/y, corresponding to an annual wood consumption of 3.2 m^3/y after installing new energy efficient wood heating system. Thus, even if bigger on the average, new houses will consume about 8.4 m^3/y less wood than current houses, which is equivalent to 16.5 MWh/y after installation of new heating systems.

The annual total wood consumption for household heating system in Kolašin is about 34,000 m^3/y, which is equivalent to 66 GWh/y. By the end of 2020, the annual total wood consumption for household heating system in Kolašin will be about 29,800 m^3/y, which is about 14% reduction comparing with the rate of wood consumption at 2008 level.

Furthermore, new systems will allow the elimination of the use of electricity for heating. This means that GHG emissions due to power production will decrease as long as new stoves will be installed in the Municipality. Table 4.8 summarizes the annual GHG emissions by the end of year 2020 for the proposed measure. In the current situation the annual electricity consumption is about 3 GWh while after the proposed measure a reduction of 14% can be achieved.

Table 4.8: GHG Emissions for Space Heating in the Residential Sector

Scenario (2020)	Annual GHG Emissions (tCO_2/y)
Predicted scenario	2,300 tCO_2/y
Proposed Measures	1,980 tCO_2/y

4.2 TOURISM SECTOR

There are two major hotels currently located in Kolašin, namely, Bianca and Lipka. Hot water demand is presently satisfied by mazut-fired boiler at both hotels.

In order to achieve the target of sustainable development of tourism industry in Kolašin, satisfying the increasing energy demand for hot water consumption and alleviating at the same time the environmental impacts due to the combustion of fossil fuels, a measure of solar thermal system for hot water production in the tourism sector in the Municipality is hence proposed.

4.2.1 Use of Solar Energy for Heat Production in Tourism Sector

Accounting for a 5% annual renovation of the existing hotels in Kolašin, it is foreseen that the installation of solar thermal systems in the residential sector of Kolašin will show the following pattern between 2010 and 2020:

- 2010-2011 (2 years): no solar thermal system will be installed in the Municipality's tourism facilities;
- 2012-2014 (3 years): 20% of the renovated tourist accommodations and all the new tourist accommodations will install solar thermal system annually, thanks to the introduction of the financial incentives;
- 2015-2020 (6 years): 100% of the renovated and new tourist accommodations will install solar thermal system annually, due to both the financial incentives and further promotion from the government.

The input parameters for the assessment of the proposed measures are summarized in the Table 4.9:

Table 4.9: Hot Water Consumption in the Tourism Industry

Parameter	Value
No. of Tourists in 2008	50,000
No. of Tourists in 2020	350,000
Water Inlet temperature	5°C
Water Outlet temperature	50°C
Hot water consumption per tourist in 2008	80 l/day
Hot water consumption per tourist in 2020	60 l/day
Collectors daily operating hours	10 h/day

It is foreseen that the total thermal energy demand of hot water in hotels in Kolašin will reach 1.1 GWh/y by the end of 2020. If the solar thermal system is installed in accordance with the proposed installation rate, it is the estimated that by the end of 2020 about 0.56 GWh/y of thermal energy for hot water will be generated by solar thermal energy; as 26% of existing tourism accommodations and 76% of new tourism accommodations will rely on solar thermal heating system for hot water production.

By considering that only 75% of hot water demand will be achieved by solar energy in the solar hot water system, it is estimated that by that time about 52% of the total thermal energy for hot water production in the sector will be generated by solar energy.

The total annual thermal energy consumption for hot water production in the tourism sector from electricity is estimated to be 0.19 GWh/y by the end of 2020. In addition, the overall consumption of mazut is decreasing as most of the thermal energy for existing tourist accommodations will be replaced by solar energy as well as LPG system. The annual thermal energy for hot water production from mazut will drop to 0.25 GWh/y by the end of 2020.

Moreover, it is noted that the annual mazut consumption is increasing during 2008 and 2014 as new hotels will be built in order to satisfy the growth in the tourism sector; it is also noted that the consumption of LPG is increasing between 2010 to 2015 as part of the renovated and new tourist accommodation buildings will install LPG system instead of mazut system. The overall thermal energy from LPG start decreasing slightly after 2015 as all the renovated and new buildings will install solar thermal system instead of LPG system and the overall

hot water consumption in the tourism sector will be declining. The total annual thermal energy demand from LPG in the tourism sector of the Municipality is estimated of the order of 0.09 GWh/y by the end of 2020.

The annual GHG emission for hot water production in the tourism sector in Kolašin for the proposed measures is hence determined based on the actual consumption of fuels. The annual emission of 2008 and 2020 is summarized in the Table 4.10:

Table 4.10: GHG Emissions for Hot Water Production in the Tourism Sector (2008 – 2020)

Year	Annual GHG Emission – Electricity (tCO_2/y)	Annual GHG Emission – Mazut (tCO_2/y)	Annual GHG Emission – LPG (tCO_2/y)	Total GHG Emission (tCO_2/y)
2008	0	686	0	686
2020	162	821	234	1,217

The annual GHG emissions for hot water production in the tourism sector is increasing with time for the baseline scenario, reaching 2,959 tCO_2/y by the end of 2020, whereas the annual GHG emissions of the proposed measures will reach 1,217 tCO_2/y, as there is no GHG emission from the solar thermal system. It is noted that by introducing the proposed measures, the annual GHG emissions will be reduced to about 1,741 tCO_2/y by the end of 2020.

Based on the above data, the total solar thermal collectors' area is estimated to be 1,151 m^2 by the end of 2020. The average annual installation of solar collectors' areas is about 22 m^2 during 2012 and 2014, after the introduction of the investment subsidies in the Municipality; the average annual installation of the solar collector area will rise to 170 m^2 between 2015 and 2020.

If the investment subsidies for solar systems will be introduced in Kolašin in 2012, the annual subsidies that will be paid by the Municipality is therefore estimated to be 2,200 EUR/y during 2012 and 2014, and about 17,000 EUR/y on average between 2015 and 2020. The overall subsidies that will be paid by the Municipality between 2012 and 2020 are estimated to be 115,000 EUR.

4.3 PUBLIC SECTOR

Solar energy for preparing domestic hot water is generally one of the easiest methods of utilization of this energy, but it has still not been used in the Municipality. Hot water heating in the public sector of Kolašin is mainly generated from electric boilers, in addition reduction of energy consumption and consequent reduction of CO_2 emissions in municipal public lighting can be provided through the use of lamps of new generation of greater efficiency.

4.3.1 Use of Solar Energy for Heat Production in Municipal buildings

The objective of the exploitation of a renewable source of energy, such as solar, permits reduction in the use of fossil fuels and, consequently, allows a reduction of CO_2 emissions into the atmosphere.

This action can be divided in three phases. In the first phase a first solar thermal plant should be built in new or under renewal public buildings. The candidate local installers, citizens of Kolašin or other places, shall be trained, providing them at the end of the courses with the professional qualification of "solar installer". In the second phase should serve to boost confidence in the new technology and in this phase it should be introduced the incentive,

granted by the Municipality or State. Third phase is characterized with the mandatory use of these technologies for all new installations, imposing the use of solar collectors in all fields on the whole Municipality. In addition, it is expected that the Municipality will introduce investment incentives for solar system in 2012 and become more progressive after 2015.

The overall thermal energy demand for hot water production in public sector obtained from solar energy is estimated to be about 40 MWh/y by the end of 2020. The corresponding thermal energy demand from electricity is estimated to be about 13.3 MWh/y, which is equivalent to 14.8 MWh/y considering 90% overall efficiency of electric boilers.

The overall annual GHG emission for hot water production in public sector in Kolašin by the end of 2020 for the predicted scenario and the proposed measures are summarized in the Table 4.11.

Table 4.11: GHG Emissions of Hot Water Production in Schools

Scenario (2020)	Annual GHG Emissions (tCO_2/y)
Predicted scenario	46 tCO_2/y
Proposed Measures	11 tCO_2/y

4.3.2 Municipal Street Lighting Lamps Replacement

It is expected that high-pressure sodium lamp will be used for 60% of new public lighting installations in the Municipality by the end of 2020. This lamps are more energy efficient, since they consume 44% less electricity than standard mercury vapour lamp providing the same light intensity.

Therefore, it is proposed that high-pressure sodium lamps will be installed in all new public lighting devices in Kolašin between 2011 and 2020; as well as all the existing public lighting street lamps will be replaced by high-pressure sodium lights. The average annual replacement rate is estimated to be about 8.3%.

The annual electricity consumption is expected to increase from 286 MWh/y in year 2008 to 457 MWh/y by the end of year 2020 based on the proposed measure. The increase in annual electricity consumption is mainly due to the increase of number of public lighting installations from 1,000 in year 2008 to 4,000 in year 2020.

Nevertheless, it is found that, in case of implementation of the proposed measures, the annual electricity consumption could be 45% lower than the predicted scenario, as the contribution of the energy efficient high-pressure sodium lamp will increase from 45% in the predicted scenario to 100% in the proposed measure by the end of year 2020.

The overall annual GHG emissions for public lighting in Kolašin by the end of year 2020 for the predicted scenario and the proposed measures are summarized in Table 4.12.

Table 4.12: GHG Emissions of Public Lighting

Scenario (2020)	Annual GHG emissions (tCO_2/y)
Predicted scenario	646 tCO_2/y
Proposed Measures	354 tCO_2/y

4.4 INDUSTRIAL AND COMMERCIAL SECTOR

It is expected that development of tourism industry in the Municipality will cause a growth rate of 3% in the annual energy consumption in the commercial and industrial sectors in Kolašin between 2008 and 2020. Therefore, an energy efficiency action is proposed also for

the commercial and industrial sector of Kolašin, aimed to maintain the annual energy consumption at 2008 level.

In addition, the Municipality of Kolašin is characterized by a rich energy potential, and most is currently unused. The highest potential is related to hydro power plants and wind farms, therefore proposed measures are related to electricity production from SHPP and wind farms.

4.4.1 Use of High Efficiency Electric Equipment in Industries and SMEs

The planned measure of use of high efficiency electric equipment in industrial and commercial sector will include organization of an information and awareness rising campaign, by setting up information sessions for the owners and employees of the companies to promote overall energy efficiency and the corresponding economic and environmental benefits.

The objective of the campaign is to replace the energy inefficient products with energy saving appliances including office equipments, lighting, electric motors and small electronic equipment, as well as to promote an efficient utilization of all devices. It is also foreseen increase of the proportion of energy saving products available in the Municipality (for instance, set minimum energy efficiency requirements for new energy-consuming products sold). Furthermore, it will be introduced a voluntary agreement among the industries and the Municipality in order to improve the energy efficiency in the manufacturing facilities, by awarding business specific benefits (i.e. white certificates, audit and export support, reduced payments, etc.).

For the commercial sector, voluntary agreements and procedural codes could be promoted between the suppliers and manufacturers, wholesalers and retail outlets, and consumers.

It is expected that the activities of the programme will start across the Municipality in year 2010. It is hence foreseen that the commercial and industrial sector of Kolašin will start implementing energy efficiency measures, for instances installing energy efficient equipment and lightings, after the beginning of the programme.

Currently, the average annual electricity consumption in the industrial and commercial sector of Kolašin is about 4.0 GWh/y. It is expected that the overall energy consumption of the industrial and commercial sector will increase due to the development of the tourism industry in the Municipality, as more shops and related industries will be opened, and the operating hours could be extended. The annual electricity consumption of the commercial and industrial sector of Kolašin will reach 6.1 GWh/y by the end of 2020.

This growth will be contrasted by the annual reduction of electricity consumption stimulated by the awareness raising campaign on high efficient electrical devices.

In accordance with the proposed measures, the GHG emissions in the commercial and industrial sector in Kolašin in year 2020 are summarized in the following tableTable 4.13

Table 4.13: GHG Emissions in the Commercial / Industrial Sector

Scenario (2020)	Annual GHG Emissions (tCO_2/y)
Predicted scenario	4,713 tCO_2/y
Proposed Measures	3,086 tCO_2/y

4.4.2 Electricity Production from SHPP

As already outlined, Kolašin has a good potential for small hydro power plants. In terms of environmental impact, the most suitable solutions are plants without reservoir, like the

existing Mušovića Rijeka SHPP. Small plants are likely to be developed by private sponsors (even Mušovića Rijeka, currently operated and owned by EPCG, is going to be privatized), and the power sale tariff for small hydro plants currently in place is related to yearly energy prices and not to instantaneous power demand. Production tuning at grid level is much easier to be performed through management of large plants.

An analysis of suitable locations has been carried out in order to calculate how much energy could be produced through small power plants. The possibilities for small hydro plants are slightly different in the two scenarios (with or without construction of the large hydro project on the Maraca). In the Morača basin, the rivers and creeks suitable for hydro power development are the upper Morača (around Levite), Ratnjia, Pozanjska, Vrela, Ibristica and Sjervenica. In the Tara basin, there are interesting possibilities on the Crnja, on the Pecka and on the Bukovica, beside the existing plant of Musovika Rjeka on the Ljevista. Evaluation results, with the Morača large hydro system, are shown in Table 4.14.

The total installed power in small hydro plants would be around 120 MW, most of which (87 MW) resulting from the two plants with reservoir, whereas the total produced power would be in the order of 250 GWh/year, out of which 144 GWh/year coming from Krusev-Lug and Ljuta plants.

Table 4.14: SHPPs Production Estimation, with the Morača HPP System Built

	Ljevista	Ratnja	Krusev	Pozanjska	Vrela	Ljuta	Ibristica	Sjervenica	Crnja	Pecka	Musovica Rjieka	Bukovica
Catchment Area (km^2)	12.5	13.5	-	7	5.5	-	9	37	8.5	4.5	>6	4
Penstock head (m)	170	80	-	370	430	-	150	210	270	230	160	260
Nominal Power (MW)	3.1	1.6	27	3.8	3.5	60	2.0	11.3	3.3	1.5	>1.3	1.5
Total production (GWh/y)	9.8	5.0	47	11.9	10.9	97	6.2	35.7	10.5	4.7	4.76	4.8

The SHPP production estimates without the Morača large hydro system are shown in Table 4.15. In this case, a total of 34 MW could be installed, with a yearly production around 115 GWh/year, without any sensible environmental impact on the river ecosystem.

The policies for promoting at municipal level a proper development of these plants do not significantly differ in the two cases. The realization of such plants will be under the responsibility of private investors.

The most limiting factors to the development of this sector, in Montenegro, are mostly related to the power sale tariffs to the grid, which do not provide safe warranties to have good payback period in the middle term. To solve this problem, a new tariff system is currently under development by the Government.

Table 4.15: SHPPs Production Estimation, without the Morača HPP System

	Ljevista	Ratnja	Pozanjska	Vrela	Ibristica	Sjervenica	Crnja	Pecka	Musovica Rjieka	Bukovica
Catchment Area (km^2)	12.5	13.5	7	5.5	9	37	8.5	4.5	>6	4
Penstock head (m)	170	150	370	510	220	210	270	230	160	260
Nominal Power (MW)	3.1	3.0	3.8	4.1	2.9	11.3	3.3	1.5	>1.3	1.5
Total production (GWh/y)	9.8	9.3	11.9	12.9	9.1	35.7	10.5	4.7	4.76	4.8

As mentioned before, besides huge potential in solar energy, the Municipality of Kolašin has significant potential in wind energy resources. The windiest areas in the Municipality of Kolašin are the mountain ridges. In particular, the place where winds appear to be stronger is Mount Torna and the surrounding mountain top, followed by the Komovi highest tops. However, these areas are not suitable for building wind power plants, due to the extremely rugged orography of these mountains and non satisfied factors for wind farm development.

After detail evaluation, two remaining ridges seem to have both good wind conditions and accessibility: Mount Kljuc and Mount Zebalac, in the North-West sector of the Moraca Valley. Therefore, the proposed action is related to energy production from two wind farms, namely Mount Kljuc and Mount Zebalac.

4.4.3 Energy Production from Kljiuc Wind Farm

This action foresees construction of wind farm on the Kljuc Ridge, which shows an excellent situation under the accessibility point of view. The area is adjacent to the Jezerine ski resort, reached by a wide road with few bends. Moreover, the existing ski slopes could allow reaching the site with minor works. A further issue making the location very suitable is the presence of a medium voltage connection feeding power to the ski plants, which could also serve for connecting a wind power plant.

The proposed area is the whole ridge, developing at 1,800 m a.s.l., starting from the municipal border going West towards Kolašin. Figure 4.4 shows ridge of Kljuc Mount.

If wind measurements confirm good wind conditions, the length of the ridge available for installation would be around 4.3 km. This would allow the installation of nearly 20 MW wind power. Under these conditions, a wind farm of 20 MW could allow production of about 35 GWh/y.

Figure 4.4: Kljuc Ridge, Mount Miljevaca

4.4.4 Energy Production from Zebalac Wind Farm

This action suggests the construction of wind farm on the Zebalac ridge, which shows better wind conditions in respect to Kljuc ridge. However, the area is less accessible and would require bigger (and more expensive) works in terms of infrastructure, even though there are some white roads reaching the site. According to preliminary evaluation, the ridge length suitable for wind power is shorter than on Kljuc, around 2.4 km. Therefore, the size of a wind farm could be around 12 MW. Thanks to higher wind power density, the capability of the plants could be slightly higher than for Kljuc, being around 23-25%, according to the wind map power density values. The energy production for Zebalac wind farm could be around 23 GWh/year. Figure 4.5 shows a photomontage of how the wind farm could be constructed on the Bucum Javorje katuns.

Figure 4.5: Zebalak Wind Farm (Photomontage)

4.5 TRANSPORTATION

Transportation is nowadays responsible of a significant amount of energy consumption and, consequently, of GHG emissions. It is hence proposed reduction of energy consumption in transport.

4.5.1 Reduction of Energy Consumption in Transport

The emissions from transportation have been calculated maintaining the same overnight stays assumed for the baseline calculations, taking into account the effects of the following measures:

- introduction of a collective transportation system from Kolašin to the ski center; this solution would aim at avoiding around 90% of the private vehicular traffic, thus reducing congestion on the way to the ski center. The aim of substituting around 90% of the current private cars is a challenging objective and implies a strong organization for the bus shifts in order not to provide a weak service. Buses shall have high capacity (50-100 people) and will be of diesel type;
- introduction of a public electric minibus service within the urban area, of bicycle paths and improvement of pedestrian paths, aimed at reducing by 20% the internal tourist demand and local transports;
- introduction of a public bus service between the most populated suburban villages (Kolašin-Babljiak-Drjienak-Lipovo, Kolašin-Crkvine, Kolašin-Matesevo after highway construction) during the summer, aimed at reducing by 15% the internal tourist demand and local transports;
- enhancement of intercity bus and renovation of the railway: railway, currently scarcely used for the national transportation, could become after enhancement of the service a useful solution to reach Kolašin from outside, helping reducing the extra urban traffic weight and the related emissions. The aim for this intervention is the reduction of emissions for extra-urban traffic by around 20%.

Each of the proposed action would lead to the emission reduction in the transport sector. Table 4.16 shows the year 2020 baseline and project scenarios for each intervention.

Table 4.16: Baseline and Project Scenarios (2020)

Category	Baseline Emissions Year 2020	Project Emissions Year 2020	Unit
Public Service Town-Jezerine	116	46	tCO_2e/y
Electric Minibuses, Pedestrian and Bicycle paths	57	0	tCO_2e/y
Local Public Bus Service	54.6	18.7	tCO_2e/y
Railway Enhancement	325	307	tCO_2e/y

Table 4.17 summarizes the GHG savings resulting from the implementation of sustainable measures in transportation, estimated to be around 5.5 % in 2020 in comparison with the baseline scenario for the same year.

The main impulse in the increase of the GHG emissions for the Municipality (+700 %) is given by the high increase in tourist presences. It is not possible to foresee a scenario in which GHG emissions and the fuel consumptions are lower than in the current situation because of the huge increase of people visiting Kolašin for tourism purposes, but the sustainable interventions will help limiting the GHG emissions.

Table 4.17: Transport - Baseline and Project Scenarios (2020)

Mean	Baseline Emissions 2009	Baseline Emissions 2020	Project Emissions	Unit
Road Transport	27,712.40	30,082.30	30,082.30	tCO_2e/y
Buses	294.90	339.10	339.10	tCO_2e/y
Trucks	403.40	463.90	463.90	tCO_2e/y
Urban Transport	1,798.50	1,798.50	1,757.80	tCO_2e/y
Tourists	136.60	977.80	823.00	tCO_2e/y
Total Kolašin	2,633.40	3,579.30	3,383.80	tCO_2e/y

A further important possibility for decreasing impacts of transportation is a gradual substitution of conventional fuels (gasoline and diesel) with cleaner ones. Among possible lower impact fuels, i.e. biofuels, methane and LPG, the latter is the only one that could achieve a good diffusion in Kolašin. Methane, in fact, needs the presence of a distribution network that is not present in all Montenegro, whereas biofuels are still too expensive and pose resource availability problems that prevent their massive introduction worldwide.

LPG is a petrol derived fuel, made by the lightest fraction coming from oil refining. Thus it is not carbon neutral, but it offers several advantages over conventional fuels

From the economic point of view, its cost in Montenegro is 40-50% lower than the normal fuels. From the environmental point of view, the hydrogen-carbon ratio is higher, thus CO_2 emissions from its combustion are about 10% lower than those of gasoline for producing the same amount of energy. But the bigger advantage is related to pollutants having effect on local air quality: carbon monoxide and nitrogen oxides emissions from a LPG fuelled car are about one order of magnitude lower than those coming from a gasoline fuelled car, whereas dust and sulphur oxides emissions are practically absent. Thus a city where all cars use this fuel instead of conventional ones would virtually eliminate car pollution problems (even if traffic would remain the same).

In Kolašin there are two fuel stations. One already offers LPG sale to cars, the second one was installing the LPG pump during Summer 2009. Thus the most common problem for using a LPG car, that is the difficulty in finding a fuel station, does not exist in Kolašin.

All existing gasoline vehicles can be converted to LPG with a cost depreciable in 10,000-20,000 km of car use, and nearly all car producers have widely began selling LPG cars at the same price of the gasoline since the end of year 2008. In both cases, an LPG car can also run with gasoline, it has two tanks and dual alimentation.

The suggestion is therefore to gradually convert and renovate the private and public vehicles of Kolašin to LPG. This could be done first with Municipal vehicles, to provide the example, and then also to private ones through an awareness campaign. Beside reducing pollution and reducing fuel costs of cars, an effect of broad diffusion of LPG cars could be the opening of LPG conversion workshops, working to install LPG plants in the cars of Kolašin citizens but

also, in the future, for those of neighboring municipalities, with a new interesting business and job creation opportunity.

4.6 ACTION PLAN

The actions identified provide the key elements to implement a sustainable energy action plan for the Municipality, preparing the 'road map' for the reduction of GHG emissions.

For each relevant sector, the selected priority actions will permit a gradual reduction of the GHG emissions.

This section summarizes the achievable GHG emission reduction through the implementation of the action in the following main sectors:

- wind and hydro power plants development;
- intelligent energy production and use in residential buildings;
- high efficient lamps in public lighting;
- sustainable transport promotion.

The overall CO_2 emission reduction calculated assuming 2008 as the baseline year and taking into account the measures proposed by the SEAP amount at 5,472 tCO_2/y equal to a 26 % decrease of the GHG emissions compared to 2008 level; it must be noted that the estimation takes into account only the interventions of energy efficiency in Kolašin, excluding the renewable projects which are part of a National strategy.

The energy planning strategy encompasses actions complementary to the achievement of the objective of sustainable energy development for sustainable tourism development. It is therefore necessary to give priority to the measures that most greatly influence the success of the objective.

The proposed actions could have different time frame for their implementation, due to the specific characteristics of the required interventions and to the involvement of private and public sector.

For instance, the timeframe for the realization of wind farms and SHPPs is difficult to estimate because of the uncertainties related to the actual involvement of private investors in the short term period.

The Action Plan summarized according to the SEAP template is presented in Appendix C. In the following are described:

- the expected emissions reduction by 2020;
- the timeframe for implementation of the proposed actions.

4.6.1 Expected Emissions Reduction Until 2020

For each relevant sector (buildings, industry, transport, land use planning, and other sectors), the selected priority actions will permit a gradual reduction of the GHG emissions.

Besides the emission factor for fossil fuels, already analyzed in the related sections, for the realizations involving the replacement of fossil fuel generated electricity, the carbon emission factor for the national grid was considered (0.774 kgCO_2e/MWh).

For wind energy, the baseline is considered equal to zero while a negative balance is achieved in the project scenario since the introduction of the new power plants will reduce the utilization of the national fossil fuelled power plants.

A similar approach was followed for hydro plants: the baseline, in this case, includes two realizations, the enhancement of Musovica Rjeka SHPP and the realization of Crnja SHPP.

The Table 4.18 summarizes the achievable GHG emission reduction through the implementation of the action in the following main sectors as identified by the SEAP template.

Table 4.18: Estimated Overall GHG Emissions Reduction - Year 2020

Measure	GHG Emissions Reduction [tCO_2/y]	Total Reduction [%]
Electricity production from SHPP	77,200	n.a.
Energy Production from Wind	44,892	n.a.
Intelligent energy production and use in residential buildings	2,850	24%
Lamps Replacement in Public Lighting	292	45%
Use of High Efficiency Electric Appliances	2,135	23%
Public Transport Enhancement and Use of LPG	196	5%
TOTAL	127,565	

Figure 4.6 shows the contribution to the overall GHG emissions reduction per each main sector at year 2020.

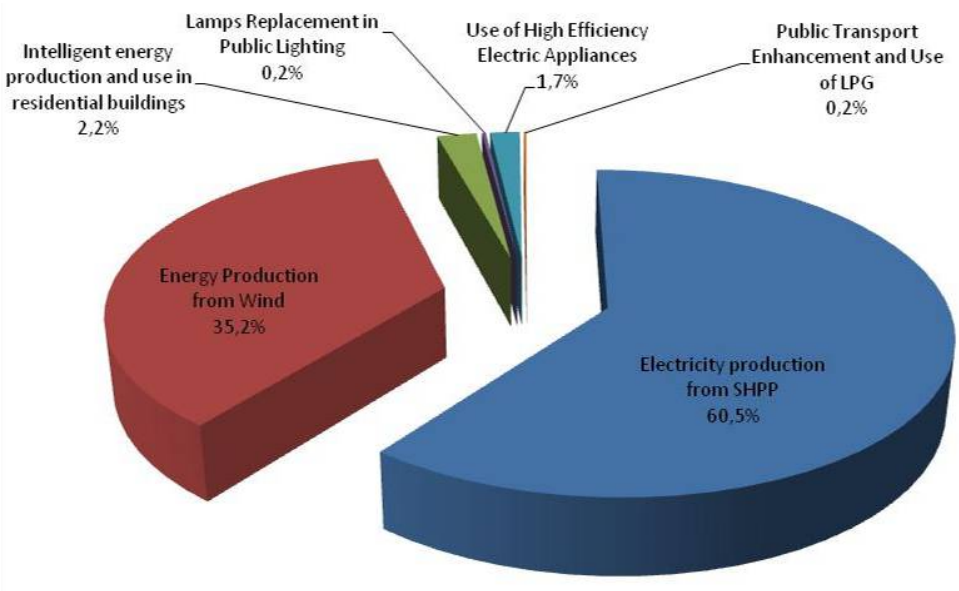


Figure 4.6: Sectors Contribution to the Overall GHG Emissions Reduction - Year 2020

According to the methodology developed for the preparation of the Sustainable Energy Action Plan and in accordance with the recommendations of the European Commission, the plan of measures and actions to reduce CO_2 emissions by 2020 contains identified energy

efficiency measures in the sectors of building, land use planning and other sector(s) of the Municipality of Kolašin.

The following Table 4.19 provides a brief description of actions planned under the SEAP, organized according to the sectors.

Table 4.19: Actions/ key measures per sector

Sectors	Key Actions	Energy saving [MWh/y]	Local RES production [MWh/y]	GHG reduction 2020 [t/y]
BUILDINGS, EQUIPMENT/FACILITIES & INDUSTRIES		**2,712**	**1,466**	**5,276**
Municipal buildings, equipment/facilities	*Use of solar energy for heat production*		*40*	*35*
Tertiary (non municipal) buildings, equipment/facilities	*Use of solar energy for heat production*		*550*	*1,742*
Residential buildings	*Use of solar energy for heat production*		*876*	*753*
	Use of high efficiency electric appliances	*610*		*507*
	Increase of efficiency in heating			*320*
Municipal public lighting	*Lamps replacement in street lighting*			*292*
Industries & SMEs	*Use of high efficiency electric appliances*	*2,102*		*1,627*
LAND USE PLANING				**196**
Transport/mobility planning	*Reduction of energy consumption in transport*			*196*
OTHER SECTOR(S)			**173,000**	**122,093**
Renewable Energy Production	*Electricity production from SHPP*		*115000*	*77200*
	Energy production from wind (Kljiuc)		*35000*	*27090*
	Energy production from wind (Zebalac)		*23000*	*17802*

4.6.2 Timeframe for Implementation

The proposed actions could have different time frame for their implementation, due to the specific characteristics of the required interventions and to the involvement of private and public sector. Therefore, the timeframe for implementation has been organized in three phases:

- Phase I: awareness raising and demonstrative initiatives;
- Phase II: voluntary subsidized actions;
- Phase III: mandatory policies.

Phase I will last at least 2 years and will have the general objective of promoting rational energy consumptions and clean energy production and to implement pilot demonstrative installation of low emission equipment.

This approach will be mainly applied to the actions focused on the residential sector. To involve and stimulate citizens, an initial information and awareness raising campaign at municipal level is expected to be implemented, aimed at highlighting financial benefits guaranteed by energy efficient equipment installation in households.

Together with information dissemination, demonstrative projects should be implemented for testing the technologies (solar thermal, wood chip plant, etc.) and for providing a real show-case.

In parallel with the initiatives in the residential sector, within the first phase of the energy strategy the Municipality shall start the Action focused on the installation of high-pressure sodium lamps in the public lighting system. It is proposed to start the lamps substitution in 2010, having as target an average annual replacement rate around 8%.

Phase II will last at least 3 years (2012-2014) and will enhance the interest of public sector, private citizens and enterprises in the development of actions for the reduction of energy consumptions and carbon emissions, without introducing mandatory policies.

This objective could be reached introducing public subsidies for the purchase and use of energy efficient technologies in buildings. The incentive could be of financial or fiscal type, or in terms of allowances for building volume increases and would help the passage from a largely black market into a legal, rules compliant and taxed market. At the same time, again, creation of local capabilities in the field of construction and renovation of houses with high energy standards would strengthen the categories of designers and construction companies of Kolašin in competitiveness in the neighboring municipalities, at the same time creating a virtuous cycle of growth of energy efficient technologies also in neighboring areas.

As regards the transportation sector within Phase II it is recommended to realize the most important actions for the enhancement of public transportation services, with specific focus on the introduction of shuttle buses from Kolašin to Jezerine, electric minibuses within the urban area, bicycle paths, public bus service between the most populated suburban villages.

The replacement of high-pressure sodium lamps in the public lighting system will continue, possibly with higher substitution rates.

Phase III will start around 2015 and continue up to 2020. After Phase II, it is expected to measure an enhanced trust in renewable sources and in energy efficient technologies. Therefore, the third phase will start introducing mandatory policies and decisions for the use of clean technologies. Incentives might continue being a good practice, both for allowing more accessible purchase and installation and for contrasting illegal work.

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APPENDIX A
OVERALL STRATEGY

Sustainable Energy Action Plan (SEAP) template

This is a working version for Covenant signatories to help in data collection. However the on-line SEAP template available in the Signatories' Corner (password restricted area) at: http://members.eumayors.eu/ is the only REQUIRED template that all the signatories have to fill in at the same time when submitting the SEAP in their own (national) language.

OVERALL STRATEGY

1) Overall CO2 emission reduction target

26 (%) by **2020**

? Instructions

Please tick the corresponding box:

☑ Absolute reduction

☐ Per capita reduction

2) Long-term vision of your local authority (please include priority areas of action, main trends and challenges)

The long-term vision of the Municipality of Kolašin foresees the development of tourism and of the community in a sustainable way. Energy is foundamental within the sustainable development. The analysis of the current situation of Kolašin showed many opportunities in the energy field. The main sectors which were investigated are: 1) the renewable including SHPP and wind; 2) the energy efficiency in the residential, tourist and public sectors.
The main proposed actions are: electricity production from SHPP, energy production from wind, energy production and use in residential buildings (i.e use of solar energy for heat production), lamps replacement in public lighting and use of high efficiency electric appliances.
The development of tourism and the increase of residential buildings foreseen by the end of 2020 involve a growth of the energy consumptions and CO2 emissions.
The Municipality has the duty to face this growth through adequate actions consisting in the adoption of new technologies (i.e. the use of solar thermal systems for the hot water production), the use of high efficiency electric equipment (i.e. fridge, washing machine), the reduction of energy consumption in transport (i.e. electric minibus service within the urban area, bicycle/pedestrian paths).
The overall CO2 emission reduction showed at point 1 (26% - 5472 tCO2/y) takes into account only the interventions of energy efficiency in Kolašin, excluding the renewable projects which are part of a National strategy.

3) Organisational and financial aspects

Coordination and organisational structures created/assigned	Project Management Team was established within the Mayor's Office according to the Article 58 of the Statute of the Municipality of Kolasin (Official Gazette of RM - municipal regulations, No. 25/04, 31/04 and 34/06).This Team deals with preparation of project proposals and implementation of projects financed through EU and national funds, as well as with future activities related to Covenant of Mayors.
Staff capacity allocated	Project Management Team is composed of 9 members, and coordinator of the Team is President of the Assembly of Kolasin. Team members have experience in gathering project ideas, providing advisory and consulting services to potential applicants, as well as in preparation, management and implementation of projects and their evaluation.
Involvement of stakeholders and citizens	In 2008-2009 meetings were held in Kolašin regarding preparation of the Master Plan for sustainable tourism development attended by representatives of public administration, businesses and citizens. On February 2010 the Master Plan was presented in Kolašin, in cooperation with Ministries of Tourism of Montenegro and of Environment, Land and Sea of Italy and the Municipality of Kolašin. Montenegro participated in the Expo 2010, in Shanghai, where Minister Nenezić presented the Master Plan.
Overall estimated budget	An overall budget was not estimated. Detailed budget for each action described in the Sustainable Energy Action Plan template will be evaluated through accurate technical and economic feasibility studies.
Foreseen financing sources for the investments within your action plan	For 2011 the Municipality planned 87000€ as funds for studies, management of hydro power and other aspects of energy production, not including annual payment for electricity consumption of 60000€. Planned expenditure for infrastructure is 250000€ including the electricity infrastructure. Other financing sources can be provided by International Donors, the European Investment Bank, the IPA funds and the European Local ENergy Assistance which has already strongly benefitted Covenant signatories.
Planned measures for monitoring and follow up	The duties of the Municipality are: 1) to periodically check the realization of the proposed actions and 2) to monitor the level of CO2 emissions sector by sector and consequentely to issue updates of the greenhouse gases emission inventory on regular basis. On two year basis the Municipality will submit an implementation report.

Go to the second part of the SEAP template -> dedicated to your Baseline Emission Inventory!

DISCLAIMER: The sole responsibility for the content of this publication lies with the authors. It does not necessarily reflect the opinion of the European Communities. The European Commission is not responsible for any use that may be made of the information contained therein.

More information: www.eumayors.eu.

APPENDIX B
BASELINE EMISSIONS INVENTORY

Sustainable Energy Action Plan (SEAP) template

BASELINE EMISSION INVENTORY

1) Inventory year 2008

For Covenant signatories who calculate their CO2 emissions per capita, please precise here the number of inhabitants during the inventory year: 9278

Instructions

2) Emission factors

Please tick the corresponding box:

- ☑ Standard emission factors in line with the IPCC principles
- ☐ LCA (Life Cycle Assessment) factors

Emission reporting unit

Please tick the corresponding box:

- ☐ CO2 emissions
- ☑ CO2 equivalent emissions

3) Kev results of the Baseline Emission Inventory

Green cells are compulsory fields **Grey fields are non editable**

A. Final energy consumption

Please note that for separating decimals dot [.] is used. No thousand separators are allowed.

Category	FINAL ENERGY CONSUMPTION [MWh]															
			Fossil fuels								Renewable energies					
	Electricity	Heat/cold	Natural gas	Liquid gas	Heating Oil	Diesel	Gasoline	Lignite	Coal	Other fossil fuels	Plant oil	Biofuel	Other biomass	Solar thermal	Geothermal	Total
BUILDINGS, EQUIPMENT/FACILITIES AND INDUSTRIES:																
Municipal buildings, equipment/facilities	620															
Tertiary (non municipal) buildings, equipment/facilities	2100			100	3300											
Residential buildings	15500												64000			
Municipal public lighting	290															
Industries (excluding industries involved in the EU Emission trading scheme - ETS)	4000															
Subtotal buildings, equipments/facilities and industries	22510	0	0	100	3300	0	0	0	0	0	0	0	64000	0	0	89910
TRANSPORT:																
Municipal fleet																
Public transport																
Private and commercial transport																
Subtotal transport						5900	4270									10170
Total	**22510**	**0**	**0**	**100**	**3300**	**5900**	**4270**	**0**	**0**	**0**	**0**	**0**	**64000**	**0**	**0**	**100080**

Municipal purchases of certified green electricity (if any) **[MWh]:**	n.a.
CO2 emission factor for certified green electricity purchases (for LCA approach)**:**	n.a.

B. CO2 or CO2 equivalent emissions

Please note that for separating decimals dot [.] is used. No thousand separators are allowed.

Category	CO2 emissions [t]/ CO2 equivalent emissions [t]															
			Fossil fuels								Renewable energies					
	Electricity	Heat/cold	Natural gas	Liquid gas	Heating Oil	Diesel	Gasoline	Lignite	Coal	Other fossil fuels	Biofuel	Plant oil	Other biomass	Solar thermal	Geothermal	Total
BUILDINGS, EQUIPMENT/FACILITIES AND INDUSTRIES:																
Municipal buildings, equipment/facilities	480															
Tertiary (non municipal) buildings, equipement/facilities	1625,4			22,7	917											
Residential buildings	12000												0			
Municipal public lighting	221															
Industries (excluding industries involved in the EU Emission trading scheme - ETS)	3087															
Subtotal buildings, equipments/facilities and industries	17413,4	0	0	22,7	917	0	0	0	0	0	0	0	0	0	0	18353,1
TRANSPORT:																
Municipal fleet																
Public transport																
Private and commercial transport																
Subtotal transport						1527,7	1106,3									2634
OTHER:																
Waste management																
Waste water management																
Please specify here your other emissions																
Total	**17413,4**	**0**	**0**	**22,7**	**917**	**1527,7**	**1106,3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**20987,1**

Corresponding CO2-emission factors in [t/MWh]	0,774			0,227	0,278	0,259	0,259						0,0			
CO2 emission factor for electricity not produced locally [t/MWh]	n.a.															

C. Local electricity production and corresponding CO2 emissions

Please note that for separating decimals dot [.] is used. No thousand separators are allowed.

Locally generated electricity (excluding ETS plants , and all plants/units > 20 MW)	Locally generated electricity [MWh]	Energy carrier input [MWh]											CO2 / CO2-eq emissions [t]	Corresponding CO2-emission factors for electricity production in [t/MWh]
		Fossil fuels					Steam	Waste	Plant oil	Other biomass	Other renewable	other		
		Natural gas	Liquid gas	Heating oil	Lignite	Coal								
Wind power	**n.a.**													
Hydroelectric power	**3968**												**0**	**0**
Photovoltaic	**n.a.**													
Combined Heat and Power	**n.a.**													
Other *Please specify: _____*	**n.a.**													
Total	**3968**												**0**	

D. Local heat/cold production (district heating/cooling, CHPs…) and corresponding CO2 emissions

Please note that for separating decimals dot [.] is used. No thousand separators are allowed.

Locally generated heat/cold	Locally generated heat/cold [MWh]	Energy carrier input [MWh]										CO2 / CO2-eq emissions [t]	Corresponding CO2-emission factors for heat/cold production in [t/MWh]
		Fossil fuels					Waste	Plant oil	Other biomass	Other renewable	other		
		Natural gas	Liquid gas	Heating oil	Lignite	Coal							
Combined Heat and Power	**n.a.**												
District Heating plant(s)	**n.a.**												
Other *Please specify: _____*	n.a.												
Total													

4) Other CO2 emission inventories

If other inventory(ies) have been carried out, please click here ->

Otherwise go to the last part of the SEAP template -> dedicated to your Sustainable Energy Action Plan

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APPENDIX C
SUSTAINABLE ENERGY ACTION PLAN

Sustainable Energy Action Plan (SEAP) template

SUSTAINABLE ENERGY ACTION PLAN

1) **Title of your Sustainable Energy Action Plan**

Energy Efficiency and Renewables Plan - Kolašin 2020

Instructions

Date of formal approval: 07.04.2011.

Authority approving the plan: Municipality of Kolašin

2) **Key elements of your Sustainable Energy Action Plan**

Green cells are compulsory fields

Grey fields are non editable

SECTORS *& fields of action*	KEY actions/measures per field of action	Responsible department, person or company (in case of involvement of 3rd parties)	Implementation [start & end time]	Estimated costs per action/measure	Expected energy saving per measure [MWh/a]	Expected renewable energy production per measure [MWh/a]	Expected CO2 reduction per measure [t/a]	Energy saving target per sector [MWh] in 2020	Local renewable energy production target per sector [MWh] in 2020	CO2 reduction target per sector [t] in 2020
BUILDINGS, EQUIPMENT / FACILITIES & INDUSTRIES:								**2712**	**1466**	**5276**
Municipal buildings, equipment/facilities	Action 1: Use of Solar Energy for Heat Production	1: Municipality	1: 2012- 2020	1: N.A.	1: N.A.	1: 40	1: 35			
Tertiary (non municipal) buildings, equipment/facilities	Action 1: Use of Solar Energy for Heat Production	1: Municipality	1: 2012- 2020	1: N.A.	1: N.A.	1: 550	1: 1742			
Residential buildings	Action 1: Use of Solar Energy for Heat Production Action 2: Use of High Efficiency Electric Appliances Action 3: Increase of Efficiency in Heating	1: Municipality 2: Municipality 3: Municipality	1: 2012- 2020 2: 2012- 2020 3: 2012 - 2020	1: N.A. 2: N.A. 3: N.A.	1: N.A. 2: 610 3: N.A.	1: 876 2: N.A. 3: N.A.	1: 753 2: 507 3: 320			
Municipal public lighting	Action 1: Lamps replacement in Street Lighting	1: Municipality	1: 2012- 2020	1: N.A.	1: N.A.	1: N.A.	1: 292			
Industries (excluding industries involved in the EU Emission trading scheme - ETS) & Small and Medium Sized Enterprises (SMEs)	Action 1: Use of High Efficiency Electric Appliances	1: Municipality	1: 2012- 2020	1: N.A.	1: 2102	1: N.A.	1: 1627			
Other - please specify: _____										
TRANSPORT:										
Municipal fleet										
Public transport										
Private and commercial transport										
Other - please specify: _____										
LOCAL ELECTRICITY PRODUCTION:										
Hydroelectric power										
Wind power										
Photovoltaic										
Combined Heat and Power										
Other - please specify: _____										

LOCAL DISTRICT HEATING / COOLING, CHPs:										
Combined Heat and Power										
District heating plant										
*Other - please specify:*_____										
LAND USE PLANNING:										**196**
Strategic urban planning										
Transport / mobility planning	Action 1: Reduction of Energy Consumption in Transport	1: Municipality	1: 2012- 2020	1: N.A.	1: N.A.	1: N.A.	1: 196			
Standards for refurbishment and new development										
Other - please specify: _____										
PUBLIC PROCUREMENT OF PRODUCTS AND SERVICES:										
Energy efficiency requirements/standards										
Renewable energy requirements/standards										
Other - please specify: _____										
WORKING WITH THE CITIZENS AND STAKEHOLDERS:										
Advisory services										
Financial support and grants										
Awareness raising and local networking										
Training and education										
Other - please specify: _____										
OTHER SECTOR(S) - ***Please specify:*** _____									**173000**	**122092**
Other - Please specify: _____	Action 1: Electricity Production from SHPP Action 2: Energy production from Wind (Kljiuc) Action 3: Energy production from Wind (Zebalac)	1: Municipality 2: Municipality 3: Municipality	1: 2012- 2020 2: 2012 - 2020 3: 2012 - 2020	1: N.A. 2: N.A. 3: N.A.	1: N.A 2: N.A. 3: N.A	1: 115000 2: 35000 3: 23000	1: 77200 2: 27090 3: 17802			
					TOTAL:			**2712**	**174466**	**127564**

3) Web address

Direct link to the webpage dedicated to your SEAP (if any)

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