Italian Ministry for the Environment, Land and Sea
Department for Environmental Research and Development

ASSESSMENT OF THE PROJECTS` POTENTIAL IN THE FIELDS OF RENEWABLE ENERGY SOURCES, ENERGY EFFICIENCY AND FORESTRY MANAGEMENT, IN THE FRAMEWORK OF CLEAN DEVELOPMENT MECHANISM OF THE KYOTO PROTOCOL IN THE REPUBLIC OF MONTENEGRO

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ABBREVIATIONS AND ACRONYMS

ACM	Approved Consolidated Methodology
AM	Approved Methodology
AWMS	Animal Waste Management System
BMS	Building Management Systems
CDM	Clean Development Mechanism
CERs	Certified emission reductions
COP	Conference of Parties
CSEM	Carbon Sequestration Evaluation Model
DNA	Designated National Authority
DOE	Designated Operational Entity
EBRD	European Bank for Reconstruction and Development
EC	European Commission
ECSEE	Energy Community Treaty for South Eastern Europe
EE	Energy Efficiency
EPCG	Electric Power Industry of Montenegro
ET	Emissions Trading
ETS	Emission Trading System
EU	European Union
GHG	Greenhouse Gases
HPP	Hydro Power Plant
HVAC	Heating, Ventilation and Air Conditioning
IMELS	Italian Ministry for the Environment, Land and Sea
JI	Joint Implementation
KP	Kyoto Protocol
KAP	Aluminum Industry Podgorica
LDC	Least Developed Countries
LFG	Landfill Gas
LULUCF	Land Use Land Use Change and Forestry
MSW	Municipal Solid Waste
MW	Municipal Waste
OECD	Organization for Economic Cooperation and Development
PAH	Poly Aromatic Hydrocarbons
PFCs	Per fluorocarbons
REC	Regional Environmental Centre
RES	Renewable Energy Sources
RoM	Republic of Montenegro
SAP	Stabilization and Association Partnership
SHPP	Small Hydro Power Plant

TPP	Thermal Power Plant
UHP	Ultra High Power
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change

THE KYOTO PROTOCOL AND CARBON FINANCE

Introduction

The Kyoto Protocol is an international treaty aimed at contrasting climate change through stabilization of greenhouse gas emissions. The Kyoto Protocol sets emission reduction targets for selected industrialized countries. Parties to the Protocol may comply with their target either by reducing their own emissions through domestic policies and measures or by acquiring carbon credits generated by emission reduction projects. Reductions projects may take place within countries Parties to the Protocol which in turn may or may not have own national reduction targets. In the cases of countries with emissions target, credits are generated through the Joint Implementation (JI) flexible mechanism, while in countries without targets (the case of Macedonia), credits are generated through the Clean Development Mechanism (CDM). Credits generated through JI and CDM can be used for compliance within either the Kyoto Protocol or the newly developed European Union Emission Trading System (EU ETS). The EU ETS is a system which sets emission quotas (or ceilings) to installations operating within selected sectors of the European Union. Similarly to the trading mechanisms developed by the Kyoto Protocol, companies may comply with such limits by reducing their emissions, by acquiring emission allowances from other companies or by acquiring carbon credits through the JI and CDM mechanisms.

The entry into force in early 2005 of both, the Kyoto Protocol and the EU ETS, have exponentially accelerated carbon market activity aimed at trading carbon emission allowances and carbon credits.

The possibility of using JI and CDM credits in the EU ETS, in the near future, will bring the prices on the EU ETS and JI/CDM markets to slowly converge. Current and expected prices of JI/CDM credits provide interesting opportunities for industrial initiatives in the JI and CDM countries. Revenues from the sale of carbon credits may have significant impacts on the financial sustainability of projects, by mobilizing cross border international investment flows in energy projects along with the associated transfer of clean technology. As a result, carbon finance is expected to play a significant role in contributing to both global sustainable development and national economic development of JI and CDM countries.

Process of ratification of the Kyoto Protocol in Montenegro

The State Union of Serbia and Montenegro became officially a non-Annex I Party to the UNFCCC in March 2001, as a successor of the FRY, which had accepted the UNFCCC back in 1997. After disunion of Serbia and Montenegro, based on the Constitutional Chapter of the State Union, Serbia became legal successor of the international instruments pertaining to the Federal Republic of Yugoslavia. Therefore, Montenegro was deprived of automatic succession of the status of party to the UNFCCC, and it is still referred as "observing party" to the Convention at the UNFCCC official website.

On 28th of June 2006, Montenegro became a member state of the United Nations by acclamation of the General Assembly. In its "Declaration on relations with the United Nations after the referendum on state-legal status", the Government of the Republic of Montenegro expressed that it will continue to conduct and observe all signed documents of the United Nations embraced in the framework of the state union. However, the practice of the UN Secretary General which is the major depositary of the UN documents shows that such "general" declarations of succession submitted by newly independent States to the Secretary-General, are not considered as a valid instrument of succession. Therefore, the process of subsequent individual successions will take time, since this sort of "legal vacuum" is not in particular relation to the UNFCCC, but to all other numerous international treaties in general.

The Government of Montenegro, recognizing it as a high priority, approved the Law on Ratification of the Kyoto Protocol in February 2006.

The Law was adopted by Montenegrin Parliament on March 21st, 2007.

The Montenegrin - Italian Cooperation Programme

The above-mentioned process is benefiting from an institutional exchange programme between the Republic of Italy and the Republic of Montenegro, launched in October 2004, with the signing of the Memorandum of Understanding aimed at co-operation on the Kyoto Protocol ratification and implementation.

The program aims at sharing experience in the areas of:

- *Development of the legislative framework necessary for the Kyoto Protocol Ratification*
- *Implementation of the National inventory system for monitoring emissions of greenhouse gases* - the system is both backward looking in tracing the historical development of the emission profiles, and forward looking in forecasting future emission trends by sector
- *Estimation of the carbon credit generation potential* – the analysis is focusing on high opportunity sectors, such as waste, renewable energies, energy efficiency and carbon sinks assessing aggregate potential, as well as identifying specific opportunities

- *Development of the national framework necessary for the implementation of the Clean Development Mechanism (CDM)* – the framework is defining roles and responsibilities, as well as prepare the necessary regulatory proposals; more specifically, it will address both the organisation and the rules of procedure of the Designated National Authority, the government entity responsible for CDM project approvals.

Process of preparation for the Kyoto Protocol implementation in Montenegro

Apart from legal issues, other technical and organizational steps have been taken in order to prepare Montenegro for implementation of the Kyoto Protocol:

- An Inter-ministerial Working Group is formed to act as transitional body, until establishing the Designated National Authority in the Ministry for Economic Development – Energy Efficiency Unit;
- GHG Inventories for 1990 and 2003 are completed; inventories for 1994 and 1998 are in the draft phase;
- Draft portfolio of CDM projects in Montenegro is updated;
- Activities on the analysis of the carbon credits potential in the Republic of Montenegro are ongoing;
- Renewable Energy Resource Assessment (Wind, Solar and Biomass) has been completed.

These activities are realized through the framework of “Cooperation for Environment Protection” between Italian Ministry for Environment, Land and Sea and Montenegrin Ministry of Tourism and Environment Protection. The IMELS’s support related to this issue is mainly recognized under the project: "*Technical assistance for the Kyoto Protocol ratification and implementation of the green certificates system*”, with the principal objective to assess the CDM opportunities in the energy, waste, forestry sectors, particularly focused on the small scale CDM projects, which benefit from simplified procedure and less value of the transaction costs, comparing to the large scale CDM projects. According to the definition, small scale CDM projects mainly refer to three categories: renewable energy projects with the capacity less than 15 MW; energy efficiency improvements projects (intermediate or end use) of less than 60 GWh/yr; and other projects with both annual CO_{2eq} emission and the emission reductions less than 60.000 tons /17/. Such projects need to result in real, measurable and long term benefits related to the mitigation of climate change, while contributing to the achievement of sustainable development goals of host countries, notably through the transfer of environmentally sound technologies.

CDM implementation is supervised by a UNFCCC body, namely the Executive Board, which is responsible for issuing the CDM credits called *certified emission reductions* (“CERs”).

By the end of 2005, the Republic of Montenegro supplied no GHG data to the UNFCCC, but now the National Inventory has been finalized, owing to the technical assistance of the IMELS. At the same

time, the Republic of Montenegro is in the process of development of national strategies and action programme towards minimization of GHG emissions. The key priorities include:

- energy efficiency programme for the industry, public services and private households,
- use of renewable energy,
- use of heat-power co-generation,
- thermal power plants restructuring and modernization,
- switch to fuels of lower CO_{2eq} emissions.

In general, numerous strategic documents related to this issue are completed or in final drafting phase. The most important ones are: Energy Policy, Energy Efficiency Strategy, Strategy for the Development of Small Hydro Power Plants, National Strategy for Sustainable Development, Foreign Direct Investment Incentives Strategy of Montenegro, etc.

Introduction

As a result of the Kyoto Protocol, carbon has become a tradable commodity with an associated value. One ton of CO_{2eq} (carbon dioxide equivalent) reduced through a CDM project, when certified by a DOE (Designated Operational Entity), is known as a CER, which can be traded. Revenue from CERs can form a part of the project's annual cash inflow, equity, or debt. Nowadays, CO_{2eq} is one of the world's fastest-growing markets - and according to Point Carbon's estimates, will be worth as much as 34 billion Euros (40,2 billion US dollars) annually, by the end of this decade.

In 2004, the global volume of trade in CO_{2eq} was just 94 million tons. In 2005, it rose to 800 million tons. In January 2006 alone, the figure was more than 262 million tons for spot trading among European players alone.

Current and expected prices of CDM credits provide interesting opportunities for investment initiatives in the CDM countries. Revenues from the sale of carbon credits may have significant impacts on the financial sustainability of projects, by mobilizing cross border international investment flows in CDM projects together with the associated transfer of clean technology. As a result, carbon finance is expected to play a significant role in contributing to both global sustainable development and national economic development of the CDM countries. OECD countries are expected to purchase between 0,5 and 0,8 billion tons of emission reductions through investments in projects that reduce emissions of greenhouse gas or enhance sequestration. Experience shows that carbon revenues are typically available for projects that: increase the efficiency of power generation; decrease losses in power and gas transmission and distribution; make use of renewable energy technologies; and improve waste management and capture landfill gases. Opportunities also exist in the agriculture, land use and forestry sectors. /2/

Summary of the potential tCO2eq at country level per sector

Republic of Montenegro has a potential to generate a large number of carbon credits over the next years by leveraging investments in the energy, waste, forestry and agricultural sectors. These opportunities can be realized through implementing projects that reduce GHG emissions or enhance sequestration.

A preliminary analysis of carbon potential of the Republic of Montenegro estimates the aggregate potential in terms of CO_2 at around 2.5 million tons of CO_{2eq} per year. Estimated carbon potentials per sector are given in the following Table 1. and described in more details in the sections below. Considering that the market price of emission reduction range between 5 and 10 Euros/ton of $CO_{2eq,}$ the resulting potential carbon investment can be expected to range between € 12 million and € 25 million per year.

Table 1.Summary of carbon credit potential per sectors

Sector	Sub-sector	Carbon potential per year, $ktCO_{2eq}$
Energy savings potential per sectors	Energy	550
	Industry	270
	Building	300
	Other[1]	150
	TOTAL	**1270**
Renewable Energy	Hydro	350[2]
	Biomass	55
	Solar	25
	Wind	120
	Geothermal	NA
	TOTAL	**550**
WASTE SECTOR (MSW + Manure treatment)		50
LULUCF SECTOR		650
TOTAL		**~2500**

[1] Including tourism sector, transportation, lighting etc

[2] Including technically useful potential only of small hydro power plants

ENERGY SECTOR

Introduction

The energy sector in Montenegro suffered from a variety of problems prior to the reform period, including under-pricing of services, lack of adequate maintenance and investment expenditures, lack of competition, excessive employment and a resulting large fiscal drain on government resources. No new major production investments have been made in the last 20 years. Local production is approximately 2/3 hydro and 1/3 coal fired thermal. The only existing thermal plant is rather inefficient and it has emission levels well beyond the EU standards. Montenegro imports about 35% of its needs (depending on rainfall and hydro production), largely due to the consumption of KAP, the large aluminium producer, which uses nearly more than 40% of the total. In fact, for the year 2007, EPCG published a tender for import of even 41% of its electricity consumption demands. In 2001, Montenegro suffered from drought-induced electricity blackouts both in summer and winter seasons. Recent efforts have been successful in improving the situation. Prices were increased by 23% in 2003, and now the average value is about 3,3 Euro cents per kWh (energy generated in Montenegro). However, electricity sales to KAP are currently set at 2 US cents per kWh, well below marginal cost. the only consumer provided with the incentives is KAP. The contract with the new private owner arranges electricity sale price to KAP in the following way: the price were set at 2,044 c€/kWh until the beginning of 2007, while from 2007 to 2010 the price will be defined according to the aluminum stock market in London and is expected to be app. 4,4 c€/kWh. The publicly owned power producer, EPCG, is currently in the initial stages of functional unbundling with the eventual goal of separation of transmission, distribution and production aspects /3/. The two tables below present energy consumption and the electricity generation balance.

Table 2. Energy consumption in Montenegro in 1997, 2005 and forecast for the years 2010 (TJ)

Fuel		Year		
		1997	2005	2010
Coal	TPP	10.242	12.528	14.616
	Other	1.321	1.252	1.451
Heavy fuel oil		3.868	4.013	4.414
Heating oil		361	682	750
Driving fuels		4.370	6.824	8.317
Liquid petrol gas		129	152	191
El. energy *		13.129	17.288	20.041
Fire-wood		1.398	1.905	2.156
Alternative sources		-	840	1.700
TOTAL		24.575	33.630	38.990

* Losses in distribution included

Table 3. Electricity generation balance in GWh /2/

	2000	2001	2002	2003	2004
Gross production	2.655	2.493	2.327	2.735	3.305
Own consumption	122	86	132	129	119
Net production	2.533	2.407	2,95	2.606	3.186
Import	983	1.406	1.382	1.426	1.397
Import from Serbia	1.198	1.236	1.187	1.227	1.198
Export	796	940	533	850	1.272
Transfer and distribution losses	471	512	514	525	694
Available for consumption	**3.918**	**4.109**	**4.331**	**4.400**	**4.509**

The estimations of the future energy demand due to the current and forecasted circumstances recognize a significant dependence on electricity import, with the growth from current 35% to 42%. Taking into consideration the annual consumption of the electricity in 2002, which was app. 4.100 GWh, and foreseen estimations with the annual growth rate of 3,2%, this leads to the value of electricity demand 6.200 GWh in 2015 /4/. The Government is in the process of preparation of different policies and measures on domestic level, which should be undertaken in order to minimize the electricity import.

There are certain indications on the extension of the national grid, by completion of more than 10 feasibility studies for lines, but no firm decision for construction has been taken so far. Financial problems explain that in average 7% of the planned projects are achieved. A new interconnection 400 kV line between Montenegro and Albania, Podgorica-Elbasan 2, has been elaborated in one of the studies. It will strengthen the links between Albania's system and the Balkan region systems and promote the regional power trade and exchange of energy, as actually bottlenecks in Greece limit the capacity of exchanges. The feasibility study notices that the construction of this interconnection line will provide the opportunity to transfer more than 1.000 GWh in 2010, and increase the flexibility of the regional grid. /4/

Legislative Background

Basic legal source in energy sector is the Energy Law adopted by the Montenegrin parliament on 25 June 2003. As mentioned above, after adoption of this law, there were several important documents designed and adopted by Montenegrin Government.

- **Energy policy (2005)**

Identifies the goals and objectives, as well as the instruments to be used by the Government of the Republic of Montenegro, aimed to develop the energy sector with respect to: secure and reliable power supply, environmental protection, ownership, market operation, investments, energy efficiency, new renewable resources, regional and broader integrations, social protection measures etc. In line

with the economic development of the Republic of Montenegro, and also with the energy practices and relevant standards for candidate countries to EU association, this Energy Policy particularly outlines the need to establish adequate legal, institutional, financial and regulatory frameworks required for sustainable development of the energy sector. The document defines the role of energy undertakings in the reform process of the energy sector and encourages both domestic and international investors to invest in new energy facilities.

- **Energy Efficiency Strategy (2005)**

  Sets as priorities:

  - Mitigation of negative effects of energy use on environment;
  - Decrease of energy import dependence;
  - Increase of efficiency in use of energy, in public, commercial and private sector;
  - Ensuring a safe, secure and reliable electro-power system;
  - Promotion of small power plants and other renewable energy sources;
  - Fostering international cooperation through participation in activities related to reduction of CO_2 emission.

- **Strategy for the Development of Small Hydro Power Plants (2006)**

Based on the signature of the Energy Community Treaty for South Eastern Europe (ECSEE Treaty), Republic of Montenegro has accepted, among the other matters, to implement the Acquis Communautaire in the field of energy, ecology, competition and development of renewable energy sources. Taking into account development of entire energy sector in the Republic of Montenegro, according to long term National Energy Strategy (its design is underway), it is assessed that the share of all renewables (not only small HPPs) in 2010/2015 can be achieved in the range of 3-5% out of total energy needs. It is calculated that the small HPPs generation can reach the share in the national electric power balance of approximately 2.5% in 2015.

Carbon reductions potential

All estimations, including the baselines and the grid emission factor calculations, were carried out on the existing methodologies adopted by the CDM Executive Board. For the Montenegrin grid, consisting of: one TPP, two HPPs and seven SHPPs, the emission factor calculation were performed by choosing the following option

The weighted average emissions (in kg CO_{2eq}/kWh) of the current generation mix /5/.

According to the chosen option defined, it was estimated, including the plan of the Government of Montenegro for the future TPP Pljevlja owner, to build a new TPP unit with the same capacity, the grid emission factor around 0,583 tCO_{2eq}/MWh. The preliminary estimation on the carbon potential of energy savings in different sectors and usage of RES in Montenegro show the value of app. 2.500.000 tCO_{2eq}/year.

Renewable Energy Potential

Renewable energy can play a significant role in future energy supply of the Republic of Montenegro by reducing import dependence, improving the environment and increasing energy efficiency. Renewable energy projects may also be supported because of the Montenegro's increased focus on employment creation, energy security, agricultural policies and the need to modernise and upgrade obsolete production capacities.

The use of RES is very promising. The region is richly forested, there are numerous river systems, solar radiation and wind energy potential are very high. Geothermal resources have not yet been exploited on any sizeable scale.

The Government has adopted the Strategy of the development of small hydro power plants in April 2006. The assessment of wind, solar and biomass potential in Montenegro, set up by the Italian Ministry for the Environment, Land and Sea, was done in December 2006 and officially presented in February 2007. This assessment is suitable to fully characterize the potential of wind, solar radiation and biomass as renewable energy source all over the Montenegro territory and it shows that there is a good potential for energy systems development for all of the three renewable energy types (wind, solar and biomass), as well as that renewable energy can play a significant role in the fuel energy infrastructure in Montenegro /16/.

Hydro energy

Montenegro has the biggest hydro potential per capita in Europe. Total electricity production capacity in 2004 was 76% of hydropower plants. The technical potential of larger installations depends on the ways of water usage: approximately 4 TWh /year in case of using the Tara river in downstream flow, or 5,3 TWh/year in case of surpassing approx. 22 m^3/s from the Tara river into the Moraca river. The use of this hydropower is an imperative for Montenegro's sustainable development, with no alternative.

Total technical installed capacity of 70 evidenced small hydro power plants (less then 10 MW) is app. 230MW, leading to annual electricity generation of app. 630 GWh. Locations of small hydropower plants in Montenegro are characterized by relatively low flows and high falls of water. For the majority of the observed water flows, measurements have not been made, which affects the credibility of estimates. Only few locations were analyzed more in depth./12/

Applying the simplified methodology for estimation the carbon potential, and considering 50% of hydro potential as the best scenario; carbon reduction could be 350.000 tCO_{2eq}/year considering only small hydro power plants.

Solar energy

Montenegro has a Mediterranean climate, being situated on the Adriatic coast. Exploration to date has shown that solar energy used in Montenegro for production of hot water can significantly improve the national energy balance.

The solar radiation maps of Montenegro (generated by satellite data, with the values of radiation on a daily basis) show a very high theoretical solar potential and it ranks above its neighbours. There is more than 2000 sunshine hours yearly for most part of the country and more than 2500 hours along the coast. Solar radiation, specifically in the coastal and central regions, is comparable to that of Greece and Southern Italy (Figure 1: solar radiation in Montenegro, in July). Specifically, Podgorica has the highest annual amount of solar energy (1600 kWh/m^{2}y) in comparison with the other major cities in the South-Eastern Europe (e.g. Rome and Athens). Considering the mapping results, the use of solar thermal energy in Montenegro is recommended, essentially by means of passive solar architecture and active solar heat /16/.

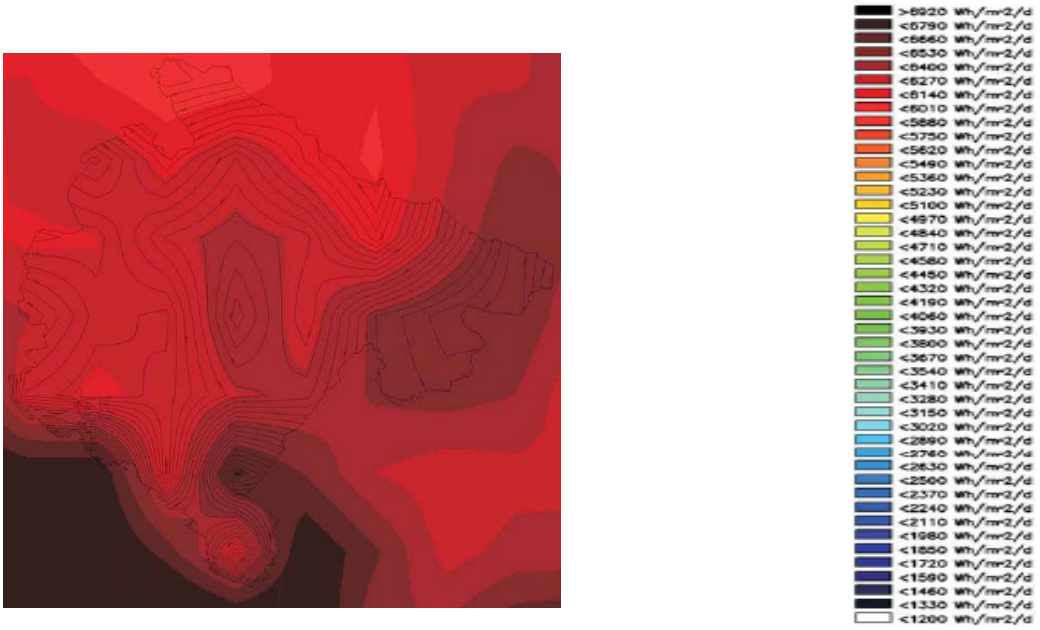

Figure 1. Average daily global solar radiation for he month of July **Legend**

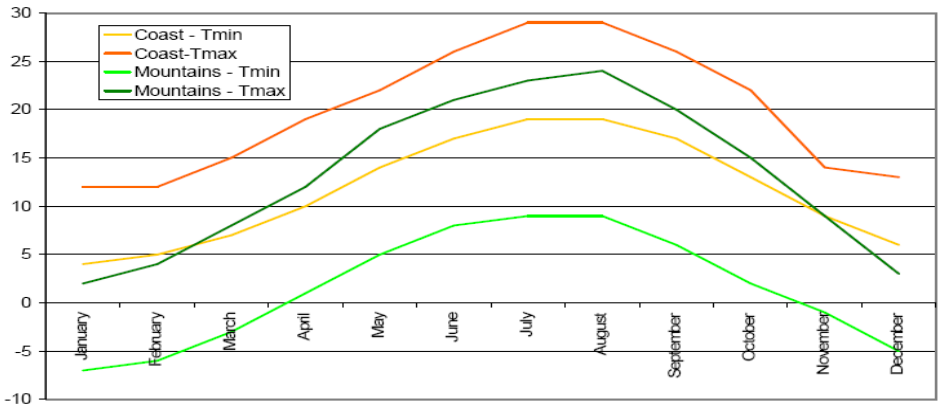

Figure 2. Temperature profile for the coastal and mountains region /16/

Solar radiation is estimated to be approximately 4 kWh/m^2 per day and has a range of maximum and minimum value of 2.6 kWh/m^2 – 4.67kWh/m^2 per day.

The results of the ground based data measured by the three meteorological stations are shown in Figure 3, in terms of average daily solar radiation per month.

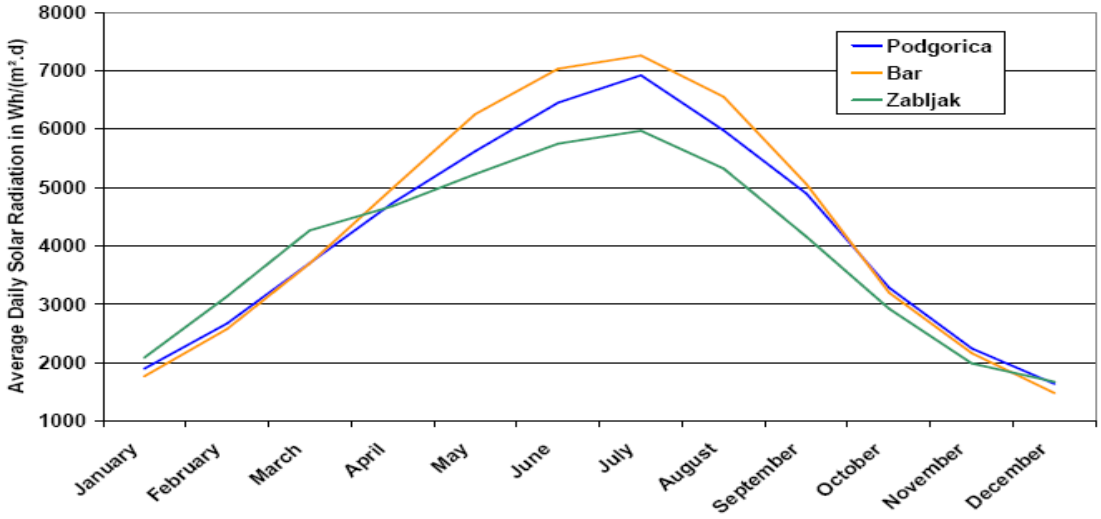

Figure 3. Average daily solar radiation between 1980 and 1986 /16/

Considering a constant growth of the tourism market in Montenegro, the tourism sector and in particular hotels along the coastline can be identified as significant target group for solar water heating systems. Since there is already a solar thermal market in Montenegro, some experience and expertise is available. Montenegro's Accommodation Capacities account for appr. 117811 number of beds (official, registered data – much higher in reality, due to a ''grey'' market) and almost the whole tourism activity in Montenegro is concentrated along the coast with about 96% of accommodation capacities.

The total sum of installed solar collectors in Montenegro is about 11.000 m^2 with installed power around 5.500 kW. That existing solar collector's installations cover only 5% of all demands for hot sanitary water. /4/

According to the data from 2001, estimated electricity consumption used for the heating of sanitary water in the residential sector was 187 GWh.

With the substitution of only 15% of the energy consumption with solar energy, the carbon reductions could be 25.000 tCO_{2eq}/year.

Wind energy

Based on the mapping activities /16/, Montenegro shows a good potential for wind energy systems in specific portions of its territory (figures 4 and 5). The wind speed in Montenegro is increasing to 5÷7 meters per second moving toward the sea, reaching 7÷8 meters per second in some areas along the coast. Besides, on the territory around Niksic. the average wind speed values are within the range of 5,5÷6,5 meters per second. Since electric lines and roads are well developed in the coastal area and around Niksic, the sites located in these areas are quite promising for wind applications.

The actual wind potential is typically between 100 and 300 W/m^2, raising in the specific windiest areas, located at the ridges and tops of mountain ranges, to more than 400 W/m^2.

The most suitable areas for wind power installations in Montenegro result in a wind potential of 100 MW (considering only the windiest areas, wind speeds above 7 m/s), increasing to 400 MW taking also into account the zones with medium potential. This potential energy output could provide up to 20÷25% of the yearly power consumption in Montenegro /16/ and decrease the GHG emissions approx. 120.000 tCO_{2eq} per year.

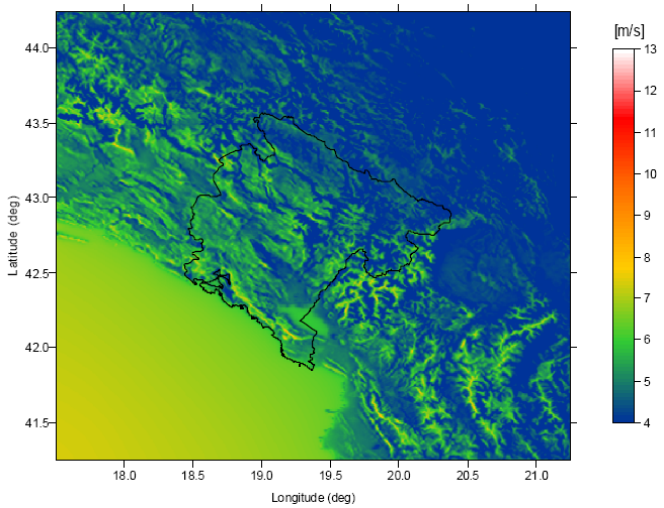

Figure 4. Actual average wind speed [m/s] at 50 m above ground level

The adopted mapping grid step was of the order of 1 km, a value allowing a good estimation of the regional wind potential but too high for the precise location of a wind farm. Also, in order to determine the location, a more detailed analysis is needed, which should take into account all the constraints, such as possible investment for improving the access road infrastructure. In general, apart for few suitable locations, small turbines (in the range of 750÷1000 kW) should be chosen in most of the potential sites. On the other hand, big wind farms would be more suitable than single, stand-alone machines, due to a faster amortization of fixed costs for the required infrastructures.

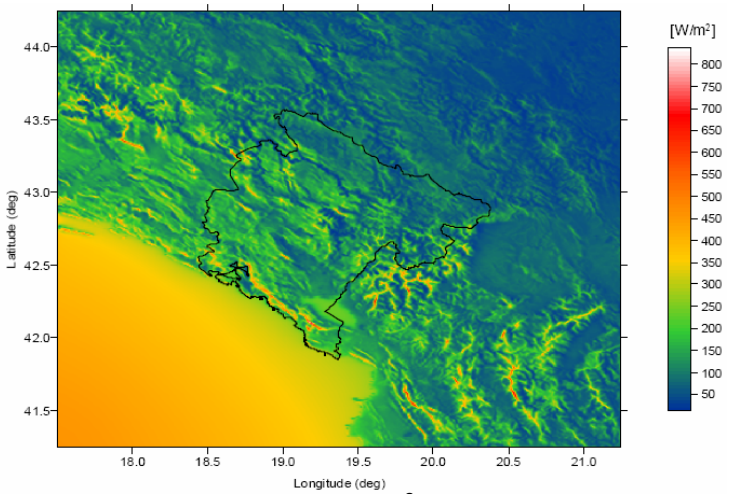

Figure 5. Actual wind potential [W/m^2] at 50 m above ground level

Wood biomass

Forests represent 36% of the overall land surface. Based on the aforesaid, Montenegro shows a good potential for biomass energy exploitation, taking also in consideration that the annual increment of forests in Montenegro is estimated at 2,6 m^3/ha, while the current utilization rate of wood from the forests is about 1 m^3/ha /16/. However, more research is needed in order to estimate the actually utilisable volume of this potential. Since the Ministry of Agriculture, Forests and Water Management is responsible for forest management in the country, it is their responsibility to give concessions on forest utilization and to determine the annual harvest volume. In that respect, in 2004, the total harvesting volume was 527.165 m^3 (gross volume), the fire-wood consumption was 169.225 m^3 and the total amount of the forest waste was 94.060 m^3 /3/. Regarding the use of wood residuals, there is an estimated potential of at least 3 to 5 small scaled power plants, with a specific capacity of 5 to 10 MW /16/. The main concessionaries are the wood-processing industries located mainly in the north parts of the country. It has been estimated that the annual emission reductions coming from the utilization of the forest wood-waste and the wood-waste, generated in wood-processing, for electricity production are around 55.000 tCO_{2eq}/year.

Energy Saving Potential

Energy efficiency is a key issue in the Republic of Montenegro, where energy consumption is more intensive than in the most developed European countries. High energy intensity could jeopardize public and private finances, cause social tensions, weaken the competitiveness of the private sector and increase costs of environmental protection through the increased emission of "greenhouse" gases. For this reason, it is important that the state undertakes all necessary measures to facilitate investments in improving energy efficiency.

Significant EE potential exists in the domain of energy production and transmission (especially in terms of distribution) and in industry. However, energy production sector (EPCG and Coal Mine) and industry sector will soon be privatized. As soon as this happens, the EE issue will become concern and responsibility of the owners. In the energy sector (consumption of energy associated with production and transportation of energy) it is realistic to expect savings of ~7%, while the loss of energy in transportation and distribution can be decreased by ~30%. Realistic potential for savings in electricity transmission through reducing losses is from 3,9% to 3% (38 GWh savings) and in distribution from 20% to 6% (311 GWh savings). In that case, total savings at the consumption level of 2003 would be about 350 GWh, or 25% of the deficit. /4/

Therefore, according to the EE Study, possible total energy savings in energy sector without significant investments in Montenegro, in overall are estimated at 13 - 13,5%, or 4.100 - 4.300 TJ in the context of the projected 2005 consumption. This savings equals to 1.140 - 1.180 GWh of electricity (which was the deficit in 1997) or 400.000 - 410.000 tons of coal (~40% of coal consumption in TPP Pljevlja) or 96.000 - 98.000 tons of fuel. Annual effect of the energy optimization at the price of 3,7 c€/kWh is ~ € 50 million. /4/. These numbers lead to the amount of the emission reductions of 550.000 tCO_{2eq} per year.

According to the findings presented in the National EE Study, minor investments in the industry can lead to significant savings, and specifically: savings in non-ferrous metals sector up to 13%, in ferrous metals sectors up to 30%. Possible savings in the rest of the industry are estimated at 7%.

The major electricity consumers in industrial sector are Steel Mill in Niksic and KAP. The Steel Mill in Niksic has a potential of energy savings as follows

- Electrical energy 26,2 GWh/year
- Heavy fuel oil ~1000 tons/year
- Coal 30.000 tons/year.
- Potential for energy savings in KAP is:
- Electrical energy 6,2% i.e. 86,2 GWh/year
- Heavy fuel oil 20% i.e. 18.000 t/year.

Considering the total potential of energy savings in the industrial sector, the emission reductions could reach the value of 300.000 tCO_{2eq} per year.

Regarding to the other sectors, such as tourism, as one of the most developed sector in Montenegro, possible measures of energy savings have been estimated at ~20%, which represents 420 TJ and include savings in all available energy sources and substitution of certain non-renewable or imported resources with renewable or non-conventional resources, primarily with solar energy in the coastal region /4/. According to the EE Study, possible potential in energy savings in the transportation sector is app. 10%, i.e. ~50TJ. In the residential sector, electricity is mostly spent for providing heat, sanitary water preparation or food preparation. The above items comprise more than 80% of the total consumption, and this represents the main EE potential for decreasing energy consumption. Taking into account heat as a final energy, the total energy saving potential in the order of magnitude of 1.100 GWh could be reached, which implies introduction of: building insulation, heat pumps, cooling energy accumulators, usage of underground waters, as addition to or replacement of the cooling systems, the automatic regulation on rational consumption of the thermal energy, solar collectors etc /4/.

WASTE SECTOR

In Montenegro, there are 21 evidenced municipal solid waste (MSW) disposal sites (around 35.000 m^3 waste per month). At 20 disposal sites, the collected waste is directly dumped on the land, without any waste treatment or protective measurements. Three regions have been identified so far in regard to the MSW origin, generation and treatment, as follows: mountainous (0,6 kg/cap/day), central (0,8 kg/cap/day) and coastal (0,9 kg/cap/day or 1,5 kg/cap/day per overnight stay - tourist). The largest dumpsites are identified in the towns of Podgorica, Pljevlja and Nikšić.

From the total generated amount of 180.000 tons/year of MSW, only 50% is being collected and disposed. The survey of the MW composition in the three regions and in the entire country is provided in the following table:

Table 4. Assumed Composition of Municipal Waste in Montenegro /7/

	All Data are in Weight Percentage (%)					
Region	Paper	Glass	Metal	Plastic	Organics	Others
Central	17	7	4	10	30	32
Coastal	25	10	5	15	20	25
Mountain	15	7	4	10	30	34
Entire Country	**19**	**8**	**4**	**12**	**27**	**30**

By simplified methodology, carbon potential of the waste sector in Montenegro is assessed at 250.000 tCO_{2eq} for the first Kyoto period.

Legislative background

In order to achieve standards and bring Montenegrin legislation into conformity with the EU directives in the field of solid and waste water management, during the year 2005, important strategic documents were adopted (Republic Strategic Master Plan for Solid Waste Management, the Waste Water Disposal and Purification Master Plan for Montenegrin Coast and Cetinje Municipality and Strategic Master Plan for the Sewerage and Waste Water for Central and Northern Montenegro), whose realisation implies EUR 670 million investment over a 25-year period.

The new Law on Waste Management was adopted in December 2005, although it will not come into force until November 2008. By adopting this Law, the existing legislation has been harmonised with EU directives in the area of waste management, in particular with the Directive 75/442/EEC on waste. As a result, a legal framework has been established and basic conditions created for implementation of the Strategic Master Plan for Waste Management for the Republic, which was adopted by the Government of the Republic of Montenegro in 2005. The Law envisages elaboration of a number of sub-legal acts to be completed with the period of 18 months after the Law is adopted. Regulation on Waste Disposal Sites and Waste Classification Regulation are already completed, elaboration of the following documents is under way: Rulebook on Waste Dumps, Guidebook on

Elaboration of Waste Management Plans, and Rulebook on Types and Manners of Waste Examination.

LAND USE LAND USE CHANGE AND FORESTRY

Forests cover 743.609 ha, or 54% of the total area of Montenegro. The state owns 500.041 ha or 67,25%, and private forest cover 243.568 ha or 32,75%. Regarding forests in the state ownership, 377.304 ha are covered with different types and forms of forests, while 117.298 ha (25%) are forestland with no forest cover. Management, protection and utilization of the state owned forests are the responsibility of the Ministry of Agriculture, Forests and Water Management of the RoM. This governmental entity is in charge of preparing the Forestry Development Strategy for the RoM, whereby the last one was adopted in 2002. It has also put in place the Afforestation Program for the Bare Lands for the period 2005-2014, in accordance with the Law on Forestry. The Program has been implemented through annual plans, and as a result, in the year 2003, 114 ha of land were reforested and 363 ha afforested. The annual increment of the forestry biomass volume has been estimated at 1 489 189 m^3.

Taking into account that afforestation/reforestation activities eligible under the CDM must be also a land-use change activities, it is of relevance to take into consideration that meadows and pastures accounted for 457.154 ha of the total country area in 2003. The land use in the Republic of Montenegro is regulated by the Law on Agriculture Land, and its implementation is under responsibility of the Ministry of Agriculture, Forests and Water Management. The total arable area in the country was 189.745 ha in 2003. However, there is no data available on the rate of abandoned agriculture land.

Carbon sequestration potential of the afforestation/reforestation activities for the first commitment period on annual basis has been estimated at 650.000 tCO_{2eq}/year.

Legislative background

National legislation in the forestry sector in the RoM comprises the following:

- Law on Forest (Official Gazette of the Republic of Montenegro, No 55/00),
- Law on National Parks (Official Gazette of the Republic of Montenegro, No 47/91, 17/92, 27/94),
- Law on Hunting (Official Gazette of the Republic of Montenegro, No 47/99),
- Spatial Plan of the Republic of Montenegro until 2000 (Official Gazette of the Republic of Montenegro, No 17/97). New Spatial Plan of the Republic of Montenegro until 2020 is in the phase of development of SEA (Strategic Impact Assessment) study.
- Preparation of the National Forest Policy is ongoing.

CONCLUSION

Republic of Montenegro belongs to a group of countries of a middle-term EU accession vision. The country has announced its intention to access the EU. Environmental legislation has been developed already, and the authorities in charge intent to consider the EU requirements in the field of environmental protection that could assist EU Accession afterwards.

Environmental action is currently planned for the fields of water supply and sanitation of dumpsites endangering groundwater quality.

However, for the future development of the country, environmental measures are boldly integrated in the national and international strategies. For instance, increase of energy efficiency for securing the energy supply, as well as recycling of waste materials, are defined as focal issues.

Taking into consideration the economical, political and legislative stability, and consequently further improvement of planning possibility for investors and having in mind the estimation of carbon potential for the country in the value of approx. 2.500.000 tCO_{2eq} annually, the country could be certainly qualified as a prospective market for environmental investments.

ASSESSMENT OF THE PROJECTS' POTENTIAL

Specific credit generating project opportunities

The tables in this chapter present specific credit generating opportunities in Montenegro. An initial summary table providing a general overview is followed by specific project descriptions.

SUMMARY TABLE				
	PROJECT TITLE	REDUCTIONS [tCO_{2eq}] 2008 – 2018	PARTNERS	STATUS
WASTE MANAGEMENT AND MANURE TREATMENT				
1	**BUNDLING OF PLJEVLJA AND NIKSIC DUMP SITES – LFG RECOVERY AND FLARING**	**128.000**	Municipalities and local Public Utility Companies	Pre feasibility
2	**REGIONAL LANDFILL "LOVANJA" KOTOR - GHG REDUCTION THROUGH GAS CAPTURE AND FLARING**	**60.000**	Regional Public Utility Company and Municipalities of Kotor, Budva and Herceg Novi	Pre feasibility
3	**LANDFILL GAS TO ENERGY AT PODGORICA LANDFILL SITE**	**201.500**	Municipality of Podgorica, Local Waste Utility Companies, Electric Public Utility of Montenegro	Feasibility study
4	**AWMS METHANE RECOVERY PROJECT FOR THE FARM "SPUZ"**	**50.000**	Farm owner	Pre feasibility
RENEWABLE ENERGY				
5	**WOOD BIOMASS TO ENERGY IN NORTHERN MONTENEGRO**	**136.000**	Municipalities of Berane, Andrijevica and Rozaje; Local wood processing companies; Electric Public Utility of Montenegro	Feasibility study
6	**WOOD BIOMASS TO ENERGY IN PLJEVLJA MUNICIPALITY**	**117.000**	Municipality of Pljevlja; Local wood-processing companies; Electric Public Utility of Montenegro	Pre feasibility

7	**SMALL SCALE BUNDLED PROJECT KRUPAC AND SLANO**	**27.000**	Ministry for Economic Development, EPCG	Feasibility study
8	**BUNDLED HYDRO PROJECT**	**152.000**	Ministry for Economic Development, EPCG	Pre feasibility
9	**SMALL HYDRO PROJECT SJEVERNICA 1**	**27.000**	Ministry for Economic Development, Municipality of Kolasin	Pre feasibility
10	**SMALL HYDRO REHABILITATION PROJECT**	**64.200**	Ministry for Economic Development, EPCG	Feasibility study
	ENERGY EFFICIENCY			
11	**ENERGY EFFICIENCY IN STREET LIGHTING**	**24.000**	Representatives of nine municipalities	Pre feasibility
12	**ENERGY EFFICIENCY IN SPORT CENTER MORACA**	**27.000**	Municipality of Podgorica, Sport center Moraca	Feasibility study
13	**CDM PROJECT ACTIVITIES IN KAP**	**2.300.000**	Private company “Salomon enterprises”.	Project concept
14	**ENERGY EFFICIENCY IN STEEL MILL IN NIKSIC**	**460.000**	Steel Mill in Niksic	Project concept
	FUEL SWITCH			
15	**FUEL SWITCH IN THE WOOD-PROCESSING INDUSTRY**	**167.500**	Wood-processing Company "Jakic", Pljevlja	Project concept
	CARBON SEQUESTRATION			
16	**AFFORESTATION OF DEGRADED LAND**	**4.800**	Directorate for Forestry of the Republic of Montenegro, Institute for Forestry, Podgorica.	Project concept

Project title: Ref. No.1	**BUNDLING OF PLJEVLJA AND NIKSIC DUMP SITES – LFG RECOVERY AND FLARING**
Project description	The aim of this project activity is to reduce methane emission from two dump sites by converting it into carbon dioxide that impacts global warming 21 times less, simultaneously reducing odour and explosion risk at the landfill. The proposed dump sites are located in two municipalities, Pljevlja, situated in the northern region of the Republic of Montenegro and Niksic located in the central region of the Republic. In such a manner, the project would introduce improvements into general waste disposal practice into two regions and in a certain way, contribute to the balance between the regions, referring to the fact that, in southern region, a regional sanitary landfill was constructed recently and waste management practice has been improved. The project activity envisages installation of equipment for LFG collection and flaring at the dumpsites. The equipment basically consists of LFG extraction wells, gas collection and gas cleaning system connected to a vacuum pump, prior to the flaring equipment. The dump site in the Municipality of Pljevlja is located 6km away from the town. This landfill site has been operational since 1987 and covers the surface of 1,5 ha. The amount of MSW disposed at the landfill is estimated at 54 t/day.The period until closure is estimated at 3 years. Over 330.000 tons of waste have been disposed at the site so far. The dump site in the Municipality of Niksic has been operational since 2003. The amount of MSW disposed at the landfill is estimated at 55 t/day. Almost all waste going to the landfill site is composed of domestic waste. Currently, LFG collection is not carried out at none of two mentioned dump sites and the LFG is released to the atmosphere Similar to the common situation in the field of MSW management throughout the Republic of Montenegro, the selected municipalities and the local Public Utility Companies, users of the dump sites, have no financial and technological means to manage, control or collect landfill gas. Furthermore, legislation requiring compulsory collection of the landfill gas from waste disposal sites does not exist either in the Republic of Montenegro or in the local Municipalities.The only requirement is to vent the landfill gas in order to avoid the risk of explosion.
Applied methodology	AMS III.G – **"*Landfill methane recovery*"**
GHG offset	It is estimated that the project has the capacity to reduce GHG emission of ***128.000*** tCO_{2eq} in total for the period 2008-2018, of which 68% from Pljevlja and 32% from Niksic dump site.
Sustainability	The project will contribute to sustainable development of the Municipalities by providing: • Odour prevention from the landfill site; • Fire and explosion prevention at the landfill site; • Positive effect in terms of enhancing human resources through introducing new technology and employment generation effect through project realization (construction and operation).
Current status	Specific technical information through questionnaires and site visit have been collected and the local site owner agreed on the project implementation.

Estimated investment cost	Around 350.000 €
Local partners	Municipalities and local Public Utility Companies

Project title: Ref. No. 2	**REGIONAL LANDFILL "LOVANJA" KOTOR - GHG REDUCTION THROUGH GAS CAPTURE AND FLARING**
Project description	The objective of the project is to collect and flare the LGF thus converting its CH_4 content into CO_2 while reducing the GHG effects. The project activity comprises of installation of a gas collection system and equipment for LFG/methane flaring/destruction. The flaring equipment will combust the landfill gas in order to convert CH_4 into CO_2, which has 21 times lesser impact on the global warming. This landfill site has been operational since summer 2004. The landfill site receives almost all MSW from the municipalities of Kotor, Budva and Herceg Novi. The total amount of MSW disposed at the landfill site during 2005 is estimated at 25.500 t. Almost all waste disposed at the landfill site is composed of domestic waste. The landfill site fulfils all EU legal requirements (Council directive 1999/31/EC), except for collection and flaring of LFG. As there is no gas collection system, LFG is currently released to the atmosphere through the existing horizontal collection wells. Regional public utility, user of the landfill site, has no technical know-how or human resources to implement LFG collection and flaring on the landfill disposal site. Legislation requiring the compulsory collection of LFG from landfill sites does not exist either in the legal framework of the Republic of Montenegro or in the Municipality. The only requirement is to vent the landfill gas in order to avoid the risk of explosion.
Applied methodology	AMS III.G – ***"Landfill methane recovery"***
GHG offset	It is estimated that the project has a capacity to avoid GHG emission of nearly ***60.000*** tCO_{2eq} for the period 2008 – 2018.
Sustainability	Global benefits will be a direct reduction of carbon emissions to the atmosphere through landfill gas flaring. The impact will be measurable, and it will be an enhancement of the progressive measures undertaken in Montenegro in collecting the landfill methane and flaring it, in order to reduce the impact of methane by the less impacting carbon dioxide. Through project implementation, technologies for LFG combustion will be transferred nationally and regionally.
Current status	Specific technical information through questionnaires and site visit have been collected and the local site owner agreed on the project implementation.
Estimated investment cost	Approximately 200.000 €
Local partners	Regional Public Utility Company and the Municipalities of Kotor, Budva and Herceg Novi

Project title: Ref. No. 3	**LANDFILL GAS TO ENERGY AT PODGORICA LANDFILL SITE**
Project description	The objective of the proposed project is to implement a landfill gas (LFG) capture system for the Podgorica MSW landfill under construction, aimed at reducing methane emissions. The capture and combustion of methane, a main component of landfill gas (40%-to-60%), in an engine generator and LFG flare will allow to generate electricity to be used on site and/or exported to the grid. The system will include 22 extraction wells connected with the LFG control plant, a condensate management system, a blower and enclosed flaring station, the LFG utilization plant. The project foresees the construction of a power plant with an estimated average installed power of 1,86 MW and an annual electricity generation of about 3.700 MWh/y. The LFG power plant will be connected to the existing network and the electricity generated will be exported to the National Electric Grid.
Applied methodology	The baseline methodology to be applied for the proposed project activity is ACM 0001 – ***"Consolidated baseline methodologies for landfill gas project activities".***
GHG offset	It is estimated that the project has a capacity to avoid emissions of nearly ***201.500*** tCO_{2eq} for the period 2008 – 2018.
Sustainability	• Significant environmental benefit associated with reduction of methane and carbon dioxide emissions in atmosphere and consequently of greenhouse effect; • Reduction of possible health risks by destroying most of non methane organic compounds, mainly volatile organic compounds and hazardous air pollutant; • Improvement of the landfill environmental conditions (containment of landfill bad odours by combusting the landfill gas); • Improvement of the landfill safety by reducing explosion hazards from landfill gas accumulation; • Direct effect related to social and economic aspects through creating new employments associated with the design, construction and operation of the LFG capture and by making the area around the project site a better and safer place to live and to do business; • Enhancing the sustainable development through the mitigation of global warming and local air pollution; • Promoting of renewable energy sources and introduction of clean and efficient technologies.
Current status	A detailed techno- economical assessment for the described project activity has been completed.
Estimated investment cost	According to the preliminary estimation, the total investment cost is approximately 1,7 M € ± 20%
Local partners	Municipality of Podgorica, Local Waste Utility Companies, Electric Public Utility of Montenegro

Project title *Ref. No. 4*	**AWMS METHANE RECOVERY PROJECT FOR THE FARM "SPUZ"**
Project description	The project consists of advanced improvement of practice of Animal Waste Management System (AWMS) in the Republic of Montenegro in order to mitigate GHG emissions. The emission reduction is achieved by the transformation of CH_4 into CO_2 through combustion of collected digester's biogas. The pig farm "Spuz" has an annual production of 16.000 pigs, with an average weight of 50 kg. The current manure treatment system is composed of barns internal sewage system, mixing tank and two open/anaerobic lagoons. In the lagoons, manure is partly digested at the ambient temperature by naturally occurring microorganisms, and solid phase settles at the bottom of the storage facility. Solid phase, collected at the bottom of the lagoon, is removed and used as fertilizer, when the lagoon is full. Anaerobic lagoons lead to direct release of CH_4, N_2O and CO_2 into the atmosphere, as a result of anaerobic digestion process that takes place inside the lagoons. Besides the existing legislation in Montenegro, that establishes strict water quality parameters not allowing manure to be discharged into water bodies, there are no laws requiring specific swine manure treatment. The baseline for this project activity could be defined as the amount of methane that would be emitted to the atmosphere during the crediting project period in the absence of the project activity. Open anaerobic lagoon will be considered as the baseline project scenario. The technology to be employed by the project activity includes installation of new covered lagoons creating negative pressure anaerobic digesters with sufficient capacity and hydraulic retention time to greatly reduce the volatile solids loading in the effluent. The system will include an efficient enclosed flare to combust the digester biogas. Possible second project phase could include utilization of biogas from manure digestion. Biogas could be used as fuel, replacing oil and electricity which is currently used for barns heating in order to maintain intensive swine growth.
Applied methodology	AMS III.D. - **"*Methane recovery in agriculture and agro industrial activities*"**
GHG offset	It is estimated that the project has a capacity to reduce GHG emission of around ***50.000*** tCO_{2eq} for the period 2008 – 2018.
Sustainability	• Protection of quality of the recipient water body • Ground water protection • Elimination of unpleasant odour

Current status	Specific technical information through questionnaires and site visit have been collected and the local site owner agreed on the project implementation.
Estimated investment cost	Around 250.000 € (including lagoon cost, gas handling cost, piping cost, flaring cost, engineering cost and CDM cost).[3]
Local partners	Private company Carine, Podgorica

[3] Estimates have been carried out based on EPA publication "US Methane Emissions 1990-2020:Inventories, Projections and Opportunities for Reductions"

Project title: Ref. No.5	**WOOD BIOMASS TO ENERGY IN NORTHERN MONTENEGRO**
Project description	The objective of the project is the construction of a regional electrical generator with 3 MW installed net capacity and annual electrical generation of around 23,4 GWh exported to the grid, using biomass residues (wood from forest and wood from sawmills) as fuel. The available biomass residues could be obtained from the wood processing industry and mainly from forests, owned by wood processing companies. According to the information received by the three Municipalities involved in this project (Berane, Andrijevica, and Rozaje), the actual quantity of wood available from forests and sawmills is about 31.000 m^3/y. However, other two adjacent Municipalities (Plav and Bijelo Polje) showed their interested in the project, therefore the total amount of wood could increase up to 57.000 m^3/y. The 3 MW plant scenario is based on the availability of the biomass residues from all 5 municipalities (i.e. 57.000 m^3/y). The regional electrical generation unit can be installed in the Municipality of Berane, located in a central position with respect to the selected municipalities, with a maximum distance of 35 km. The facilities and infrastructure of the old paper factory can be used for installing the new plant.
Applied methodology	AMS - I.D ***"Renewable electricity generation for a grid"***
GHG offset	It is estimated that the project has a capacity to avoid emission of around ***136.000*** tCO_{2eq} for the period 2008 – 2018.
Sustainability	The following non-GHG related social and environmental benefits have been identified as a result of the project: • Increased rate of employment; • Enhancing of the sustainable development of the region; • Optimization of the use of natural resources; • Improvement of wood residues management and disposal in the area; • Promotion of renewable energy sources and introduction of clean technologies; • Diversification of the sources for electricity generation.
Current status	A detailed techno- economical assessment for the described project activity has been completed.
Estimated investment cost	The Estimated investment for 3 MWe Power Plant for power-only production is approximately 7,5 mil EUR ± 10%.
Local partners	Municipalities of Berane, Andrijevica, Rozaje, Plav and Bijelo Polje, Ministry for Economic Development, Electric Public Utility of Montenegro, local wood processing companies.

Project title: Ref. No.6	**WOOD BIOMASS TO ENERGY IN PLJEVLJA MUNICIPALITY**
Project description	The objective of the project is the construction of an electrical generator with up to 6 MW installed capacity and annual electricity generation of around 40 GWh exported to the grid, using wood biomass and residues from wood industry as fuel. The amount of available biomass is 25.900 tons per year[4]. The project idea foresees an involvement of two main concessionaires located on the territory of one municipality. Major part of the fuel wood derives from not-harvested forests, already taken under concession by privately owned companies for wood-processing, but due to the low production intensity and their difficult financial situation, the forests remain un-harvested. Taking into account that wood processing companies, in hold of concessions, are currently working with low productive capacities, it has been suggested in the project idea note to install 3 MW of capacity with the electricity output of 20 GWh, instead of 6 MW, in order to enhance the project sustainability, as well as resistance to possible increase of production intensity. In that respect, calculations of GHG reductions have been performed and listed in the section below. According to the business as usual, biomass residues from the wood processing industry are not being stored in a proper way, but left to decay in the open-air space, releasing methane to the atmosphere. In general, the issue of wood waste represents a significant problem for some of the municipalities. Public utilities have no means to manage, control, collect or use the biomass residues, due to the lack of funds and obsolete technologies. Also, high percentage of concession remains untouched, although foreseen for harvesting in the national forest programme and therefore offered to concessionaires. On the territory of the selected municipality, there are no wood-to-energy systems already in place that would involve elements such as wood-chips production, storing, drying and feeding into the generator.
Applied methodology	AMS - I.D ***"Renewable electricity generation for a grid"***
GHG offset	It is estimated that the project has a capacity to avoid emission of around ***117.000*** tCO_{2eq} for the period 2008 – 2018.
Sustainability	The following non-GHG related social and environmental benefits have been identified as a result of the project: • Increased rate of employment • Support to sustainable development of the region • Optimization of the use of natural resources • Improvement of waste management in the area • Promotion of renewable sources of energy and introduction of clean and efficient technologies • Diversification of the sources for electricity generation

[4] Values of wood density used in calculations are 800 kg/m3 for hardwood broadleaves and 600 kg/m^3 for coniferous (ref. Olesen et al, Guideline for Estimation of Renewable Energy Potentials, Barriers and Effects, 1997)

Current status	Specific technical information through questionnaires and site visit have been collected and the local site owner agreed on the project implementation.
Estimated investment cost	Estimated investment cost for the CHP unit (steam turbine) with installed capacity of $3MW_{el}$ / $5MW_{th}$ is around 7,65 mil EUR, while installing of 3MW for power-only production could cost around 6,77 mil EUR.
Local partners	Municipality of Pljevlja; Local wood-processing companies; Electric Public Utility of Montenegro

Project title: Ref. No. 7	**SMALL SCALE BUNDLED PROJECTS KRUPAC AND SLANO**
Project description	The objective of the project is to generate renewable electricity using hydroelectric resources, and to export the generated electrical output to the Montenegrin grid on the basis of power purchase agreements (PPAs), using the Electric Public Utility of Montenegro (EPCG) transmission system to wheel the energy. The project activity will generate GHG emission reductions by avoiding electricity generation and CO_2 emissions from thermal power plants that would be generated otherwise. The two reservoirs, Krupac and Slano, already exist and the water deriving from them is used for the needs of the large Perucica HPP, according to an appropriate water discharge scheduling during the year. The new SHPPs are foreseen to use the discharged water without influencing the existing scheduling. The project includes the construction of two SHPP with the total installed capacity of 6,640 kW, corresponding to annual electricity generation of 4,500 MWh. It has been foreseen to construct SHPP Slano with two turbine units, 2.880 kW each and SHPP Krupac with one turbine unit of 880 kW. Higher energy productions could be generated optimising the discharge scheduling without influencing the daily level/volume scheduling. The SHPPs Krupac and Slano will supply the electricity generated to the state electricity grid via a sub-station and overhead transmission line. Both facilities are characterized by access roads in good conditions. The plants will be connected to the network through two power lines of 35 kV (inlet-outlet).
Applied methodology	The simplified methodology for small-scale projects AMS I.D.-***"Renewable electricity generation for a grid"*** has been applied.
GHG offset	It is estimated that the project has a capacity to avoid emission of nearly ***27.000*** tCO_{2eq} for the period 2008 – 2018.
Sustainability	• Small hydro is a renewable, non-polluting and environmentally friendly source of energy • Besides the global environmental benefit of GHG emission abatement, direct effects of the project related to social and economic aspects are job creation, income distribution and improvement of the local economy • Other very important effect is the increased availability of a reliable electricity supply and experience in accommodating smaller distributed resources that offer potential energy, capacity, and diversification benefit
Current status	A detailed techno- economical assessment for the described project activity has been completed.
Estimated investment cost	According to the preliminary estimation, the total investment cost is approximately 7 millions EUR ± 20%.
Local partners	Ministry for Economic Development , EPCG

Project title: Ref. No.8	**BUNDLED HYDRO PROJECT**
Project description	The Electric Public Power Company of Montenegro (EPCG) is in the process of establishing the list of potential SHPP projects that should be offered on concession by the end of this year. The project developer who obtains the concession on the construction of SHPPs could develop a CDM project with a significant potential of CERs, by means of bundling a couple or a few SHPPs on one river flow. This potential depends on the total installed capacity of the bundled projects, on the modality of bundling, as well as on the value of the carbon emission factor for Montenegro. Due to the latter, the following project activity could be suggested as an example: two bundled SHPPs on the river Bistrica: SHPP Zdravac and SHPP Buce, with the objective to generate renewable electricity using hydroelectric resources. All electricity generated from these projects will be sold to the EPCG. The EPCG will dispatch the electricity from the hydropower projects to the end-users connected to the national power grid. The rationale for grouping all the projects in one is based on the fact that one company will build, operate and own both facilities. The project activity will generate GHG emission reductions by avoiding electricity generation and CO_2 emissions from the coal fuel-fired power plant. The construction of two small hydro power plants, one run-of-river type and another one reservoir type with small accumulation volume, with the capacity of 2.400 kW and 11.500 kW, respectively, has been foreseen. The project activity would supply the state electricity grid with the electricity in the amount of ~ 26 GWh/year. The project activity could be developed as a project with the medium-high CDM potential. The barriers issue should be checked, especially the investment barrier, which depends on the Government's incentives on the price of electricity from the renewable energy source, such as hydro energy. Since the construction of SHPPs in Montenegro is not a common practice yet, it could be said the project activity is additional. In order to decrease the transaction cost of PDD preparation in case of separately considered SHPPs Zdravac and Buce, the two locations have been bundled in one CDM project activity.
Applied methodology	Since the total installed capacity of the two bundled SHPPs is less than the limit of 15 MW, the simplified methodology for small scale projects ***"Renewable electricity generation for a grid"*** I.D has been applied for the calculation of GHG emission reductions.
GHG offset	It is estimated that the project has the capacity to reduce emissions of nearly ***152.000*** tCO_{2eq} for the period 2008-2018.
Sustainability	The project activity will generate and supply the national grid with electricity, in a renewable, sustainable and environmentally friendly manner. One of the most positive aspects of the project implementation is the local companies' involvement and job creation, as well as a uniform electricity consumption for the area of the municipality where the projects would be developed.
Current status	Specific technical information have been collected through questionnaires and site visits.
Estimated investment cost	In the range of 12 to 16 millions EUR
Local partners	Ministry for Economic Development, EPCG

Project title: Ref. No. 9	**SMALL HYDRO PROJECT SJEVERNICA 1**
Project description	The project activity could involve setting up a run-of-river small hydro electric project near the town of Kolasin, in the northern part of Montenegro. The project is planned across a perennial river called "Sjevernica" which is a tributary of the Moraca river, one of the major flowing rivers in Montenegro. According to the average discharge of 3 m^3/s and the head of 25 m, the installed capacity of the plant could be app. 650 kW, and the annual electricity generation app. 4.600 MWh. There is a possibility to increase the capacity using more water and a higher head, that could be considered in a detailed analysis i.e. feasibility study. It would not generate so many GHG emission reductions, but in case of bundling with some other projects developed in the same river basin and by the same developer, the value of GHG emission reductions could be increased. The generated renewable electricity would supply the Montenegrin grid. The project activity will generate GHG emission reductions by avoiding electricity generation and CO_2 emissions from the lignite fuel-fired power plant.
Applied methodology	The simplified approved methodology AMS I.D. ***"Renewable electricity generation for a grid"*** for the small scale projects has been applied.
GHG offset	For the period 2008-2018, it is estimated that the project has the capacity to reduce emissions of app. ***27.000*** tCO_{2eq}.
Sustainability	• Beside the global environmental benefit of GHG emissions abatement, the project will notably improve the quality of electricity service in the region of the Kolasin Municipality • Furthermore, since a major problem in the region is a lack of access to the electrical energy, rural electrification of local communities will be a major local benefit • The project will provide employment to the local residents, both during construction and operation, in the area where permanent and reliable sources of employment are scarce.
Current status	Specific technical information through questionnaires and site visit have been collected and the local site owner agreed on the project implementation.
Estimated investment cost	App. 1 million EUR
Local partners	Ministry for Economic Development, Municipality of Kolasin, EPCG

Project title: Ref. No.10	**SMALL HYDRO REHABILITATION PROJECT**
Project description	This project activity could involve the rehabilitation and upgrade of seven existing SHPPs in Montenegro, with the total installed capacity up to 9 MW, operated by EPCG (See below Table 5.).The first of them was built in 1910 and others in 1930's and 1950's, without any major rehabilitation or modernization of the equipment meanwhile. Beside that, the hydrology status has been changed in respect to the design parameters, what results currently in a rather inefficient exploitation of the hydro resources, and plants in very poor conditions. According to the techno-economical analysis performed, the potential rehabilitation is focused on the upgrading of SHPPs, reduction of losses, improvement of reliable operation. Therefore, it increases availability and electricity generation. The latter refers particularly to the repair of weirs, overhaul of the concrete works, repair and/or replacement of turbines, generators, other electrical parts, control and automation systems, as well as the auxiliary system etc. By involving the above improvements, the existing annual electricity generation of 15 GWh could be more than likely increased up to 26 GWh. /11/
Applied methodology	The simplified approved methodology AMS I.D. ***"Renewable electricity generation for a grid"*** for the small-scale projects has been applied.
GHG offset	According to the preliminarily estimations, the emission reductions could achieve the amount of ***64.200*** tCO_{2eq} for the period 2008-2018.
Sustainability	By the implementation of the described project activity, the existing SHPPs in Montenegro will operate at full output i.e. with maximum production, with higher availability, remotely and more safely for both personnel and the environment.
Current status	Pre-feasibility study has been carried out so far.
Estimated investment cost	According to the latter table the maximum investment costs are 7,35 millions EUR.
Local partners	EPCG, Ministry for Economic Development

Table 5. Summary of the analysis of the existing SHPPs in Montenegro

No.	SHPP	Today exploitation				Modernisation		Annual Production		Max. investment
		Q [m3/s]	*Head [m]*	*P [MW]*	*No. units*	*Upgrade*	*Rehabilitation*	*Actual [MWh]*	*Future [MWh]*	*millions of EUR*
1.	Glava Zete	29	21,5	5,35	2	X		7200	13800	3
2.	Slap Zete	26	6	1,19	2	X	X	2680	4523	2
3.	Rijeka Musovica	1	160	1,26	3	X		3400	4760	1,25
4.	Savnik	1	23,5	0,18	2	X	X	420	690	0,6
5.	Rijeka Crnojevica	3	22,7	0,56	1		X	270	1170	0,2
6.	Podgor	0,9	54	0,39	1		X	700	770	0,15
7.	Lijeva Rijeka	0,2	31	0,05	1		X	8	165	0,15
	TOTAL	61,1	318,7	8,98	12			14678	25878	7,35

The Government of Montenegro intends to publish the tender for the privatization of all above-mentioned SHPPs in Montenegro by May this year.

Project title: Ref. No. 11	**ENERGY EFFICIENCY IN STREET LIGHTING**
Project description	The project activity consists of improving the existing street lighting system in nine municipalities in Montenegro, with approximately 300.000 inhabitants, by means of more efficient lighting technologies. According to the EE Strategy, by providing a good selection of the lightings and automatic lighting regulation, it is possible to obtain energy savings of 20 - 25% in this field. At present, there is a wide usage of obsolete bulbs made with mercury. They consume more electricity for the same magnitude of light and their lifetime period is one year, which is three times less compared to the bulbs made with sodium. Therefore, the project activity would consist of replacing more than 11.450 bulbs made with mercury by the modern ones made with sodium. Based on this, the energy efficiency would be increased, while electricity consumption and maintenance costs would be decreased, due to a longer lifetime period of high pressure sodium bulbs. The result of the project activity would be the electricity savings in the amount of 4.300 MWh per year, and the GHG emissions reductions. Energy efficient lighting projects do not contribute significantly to the reduction of carbon emissions. However, when packaged as part of a bigger project, they can make a significant contribution to the reduction of CO_2 emissions. Maintenance and proper care (during monitoring periods) should be taken to ensure the ongoing use of the new lighting system. This project could be a basis for defining and predicting the possibilities for development of a relevant larger project, for example lighting efficiency improvement in street lighting in the entire country.
Applied methodology	The calculated emissions reductions are under the maximum limits of the small scale methodology ***"Demand-side energy efficiency programmes for specific technologies"*** – II.C, which could be applied in this project.
GHG offset	This project activity is considered as bundling one for nine municipalities. It is estimated that the project has a capacity to avoid emission and over ***24.000*** tCO_{2eq} for the period 2008-2018.
Sustainability	The project will improve the power availability and quality of light in the local area. In addition, the project aims at contributing to an economically, environmentally and socially sustainable development of the region.
Current status	Specific technical information through questionnaires and site visit have been collected and the local site owner agreed on the project implementation.
Estimated investment cost	Investments: - for material: 750.000 € - for replacement works: 130.000 € SUM of investments: 880.000 € Annual savings: - savings due to the reduction of electricity consumption: 253.300 €/year - savings due to longer lifetime period of bulbs (works and material): 60.400 €/year

	SUM of annual savings: 313.700 € In first two months of year 2007, price of electricity was increased on the level of 0,06 €/kWh due to larger electricity imports. Therefore, estimated payback period is 3 years.
Local partners	Municipalities of Herceg Novi, Niksic, Berane, Bijelo Polje, Danilovgrad, Plav, Pljevlja, Tivat and Ulcinj

Project title: Ref. No. 12	**ENERGY EFFICIENCY IN SPORT CENTER MORACA**
Project description	The project idea is to install a HVAC system in the ''Moraca'' sport centre (a public company, located on the riverbank in the central part of Podgorica) using ground water and replacing a ''classic'' heating/cooling system: two boilers which use fuel oil for heating – app. 1.025.000 liters/year and electricity for cooling, thus reducing CO_2 emissions to zero. This approach of using heat pumps is very important for Montenegro because Podgorica, as the main urban energy consumer, lies on an underground lake. Since the current equipment for the heating/cooling system is 20÷30 years old, further investment in it would not be worth. In order to significantly improve energy efficiency, all current system should be replaced with new technologies. In this case the project activity comprises the implementation of the following components: • The air handling units with rotary regenerator leading to energy savings-app. 80% of heating energy, 50% of cooling energy and providing better comfort, The ventilators with frequency regulation mode, saving the motor drive energy, • Building Management System, method for control, monitoring and optimization of facilities, • New ducts and air distribution system • Heat pumps, replacing existing boiler • Transformer room with the power of 1,3 MW. By the implementation of the latter the GHG emissions from the combustion of app. 1.000.000 liters of fuel oil in the boilers for the heating purpose will be reduced almost to zero.
Applied methodology	The approved methodology for small scale projects AMS.II.E.- "***Energy efficiency and fuel switching measures for buildings*** " could be applied.
GHG offset	It is estimated that the project has a capacity to avoid emission and over ***27.000*** tCO_{2eq} for the period 2008-2018.
Sustainability	The project activity will considerably fulfil the sustainable development criteria regarding to: • Implementation the new technology using renewable energy source and therefore without negative effect on environment; • Increase the energy saving and reducing fossil fuel demand; • Enhance the professional cooperation and the expertise.
Current status	A detailed techno-economical assessment for the described project activity has been completed.
Estimated investment cost	The estimated investment cost according to the feasibility study is 4,9 millions EUR.
Local partners	Municipalities of Podgorica, Sport Center Moraca in Podgorica

Project title: Ref. No. 13	**CDM PROJECT ACTIVITIES IN KAP**
Project description	It should be emphasized that this non-ferrous metal industrial complex has a vast potential from the CDM point of view. Two aspects could be considered hereby: energy efficiency measures and PCFs emissions reduction in primary smelter. KAP is a plant with the highest participation in GDP, as well as in the value of exported goods in Montenegro. It has been privatized by foreign back company Salamon Enterprises, in 2005. The annual production of primary aluminum is app. 102.000 tons. This aluminum industry consumes over 1.600 GWh of electricity per year (60% of the total energy consumption in the industrial complex; it requires secure and continuous supply), app. 87.700 tons of heavy fuel oil (~40%), while other fuels, heating oil and liquid petrol gas, represent less than 0,5%. The major consumer of electricity is Aluminum Electrolysis unit (series A and B) with 92,5%, while the major consumer of heavy fuel oil is Alumina Plant with 85%. The main opportunity for the electrical energy consumption reduction, in the absence of significant technological breakthroughs, is to maintain voltage of cells at the norm prescribed value and to decrease the anode effect. It is also necessary to technically enable the electricity generator to be hooked up to 10 kV systems and to work in co-generational mode./4/ As it was already described in the introductory part of this document, the realistic annual electricity savings could reach the value of 82,6 GWh and savings in fuel oil consumption could reach the amount of 18.000 tons. From the environmental point of view, there is a huge CDM potential in the Electrolysis unit in regard to PCFs emission reductions, by modernizing the existing electrolytic cells and installing the gas collection hoods with the feeder for the alumina; in such a way, cutting down the anode effect frequency and the PFCs emissions from the smelter is enabled. Two PFCs, carbon tetra fluoride (CF_4) and carbon hexafluoride (C_2F_6), are known to be emitted from the process of primary aluminium smelting. The project would also reduce anode consumption leading to proportionate reduction of CO_{2eq} from anode depletion process. Considering the latter, two large CDM projects could be developed in KAP, resulting in very significant values of energy savings and CERs.
Applied methodology	Depending of the energy efficiency measures involved, a new methodology should be developed due to the existence of prospective large scale project, since the energy savings are above 60 GWh and GHG emission reductions above 60.000 tCO_{2eq}. Regarding to the PFCs emission reductions, there is a possibility to apply the approved baseline methodology AM0030 ***"PFC emission reductions from anode effect mitigation at primary aluminium smelting facilities"***, that will depend on the existing smelting technology in KAP.
GHG offset	According to the presented data in terms of the energy savings, app. ***2.300.000*** tCO_{2eq} for the period 2008-2018. The potential of PFCs emission reductions could also be calculated, according to the approved methodology, but more data are needed and a detailed assessment should be carried out. It is likely that a significantly higher value of CERs could be obtained comparing to the previous case.
Sustainability	The implementation of the above mentioned measures comprises the following sustainable

	development issues: • Sustainable performance of the plant and improvement in production efficiency, as well as decrease of the electricity and fossil fuel consumption • Contribution towards mitigating the electricity supply deficit in the country by improving energy efficiency • CO_2 abatement and reduction of PFCs emissions • Contribution towards additional value creation for the shareholders through improvement of technology and production capacity without increase in raw material consumption • Contribution towards creating skilled labours.
Current status	Specific technical information through questionnaires and site visits have been collected. The meetings with the representatives of the owner have been held.
Estimated investment cost	NA
Local partners	Private company “Salomon enterprises”

Project title: Ref. No. 14	**ENERGY EFFICIENCY IN THE STEEL MILL IN NIKSIC**
Project description	The Steel mill in the town of Niksic is the only steel alloys and steel reinforcement rods producer in Montenegro. It produces mainly engineering steels along with a small quantity of special high-alloyed steel grades. This steel factory has a Steel Making Shop with two UHP furnaces of 60-tons capacity, 3 electric arc furnaces, an ASEA SKF unit for ladle treatment and a billet continuous caster. Its capacity in the actual state, without any restructuring, is estimated at 190.000 tons per year. There are four hot rolling mills, a blooming mill with the rated capacity of 80.000 tons per year, and a light selection mill with the rated capacity of 25.000-35.000. The capacity of the forging plant is 10.000 tons per year, of the drawing mill 49.000 tons per year of drawn steel, 8.500 tons per year of peeled steel and 3.360 tons of ground steel. The only production line which is technologically obsolete and should be replaced with a modern one is the light section mill. All the others are technologically sound and can be refurbished and modernized for the production of high quality engineering steels. Regarding to the project activities that could result in GHG emissions reduction, the processes of optimizing consumption and increasing efficiency of fossil fuel usage have the biggest potential, particularly the usage of "waste" heat of industrial water and exhaust gases of heating furnaces. The following potential savings could be obtained: • By modernization of the electro-arc furnaces, electro-resistant furnaces and electro-motor drive, the consumption of electricity could decrease by ~ 26 GWh; • By using the heat from exhaust gases from different kind of furnaces, the annual consumption of heavy fuel oil could decrease by ~ 1000 tons; • By heat pumps installation, which would use the wasted heat for heating purposes, the annual consumption of coal would be reduced by ~ 30.000 tons.
Applied methodology	Since the total GHG emission reduction are less than 60.000 tCO_{2eq} and electricity savings are less than 60 GWh the approved methodology for small scale projects AMS.II.D.- "***Energy efficiency and fuel switching measures for industrial facilities***" could be applied.
GHG offset	According to the presented data, the preliminary estimation of the amount of GHG emission reductions results ***460.000*** tCO_{2eq} for the period 2008-2018.
Sustainability	The project will contribute to the sustainable development of the local area by mitigating negative effects related to high energy consumption and GHG emissions per unit of production, through maximizing energy efficiency and introduction of the new technology to the steel factory.
Current status	The described project activity has been defined according to data from existing official documents such as strategies, technologies needs, assessments and through plant visit. The local site owner agreed on the project implementation
Estimated investment cost	NA
Local partners	Privatized Steel mill in Niksic

Project title: Ref. No.15	**FUEL SWITCH IN THE WOOD-PROCESSING INDUSTRY**
Project description	The objective of the project is the use of biomass instead of fossil fuel, in order to meet the energy requirements of the wood-processing company. The production programme of the company includes cutting construction elements, panels, final products and prefabricated structures. The company has a concession on around 160.000 m^3 of forest wood, out of which around 20% stays un-harvested, due to low intensity of production. The forest wood that has not been used in the production process, together with residues generated during the wood processing, could be used for electricity production but also for a fuel switching within the company's facilities. At the annual level, production capacities of the company are made of: 75.000 m^3 of cutting construction elements, 60.000 m^3 plywood panels, and 56.000 pieces of carpentry and 32.000 m^2 of prefabricated structures. Wood residues from timber and wood processing are not being managed in a proper way. They are rather left to decay in the open-air space, releasing methane to the atmosphere. They are not being used in production process as fuel, while the company's annual consumption of fossil fuel is 14.400 tons of coal and 195 tons of oil. Installation of the boiler with thermal capacity of 8 MW would be sufficient to switch from fossil fuels to biomass consumption.
Applied methodology	AMS-III B – ***"Switching fossil fuels"***
GHG offset	Reduction of GHG emissions has been evaluated to be ***167.500*** tCO_{2eq} for the period 2008 - 2018.
Sustainability	• Clean technology for thermal energy production will be introduced • Issue of wood waste generated through regular forest harvesting activities would be solved in an environmentally friendly manner • The project activities contribute to the sustainable use of natural resources
Current status	Specific technical information through questionnaires and site visit have been collected and the local site owner agreed on the project implementation.
Estimated investment cost	Installation of wood chips-fired boilers with thermal capacity of 8MW, would cost around 1,32 mil EUR, according to the technology market prices in the Western Europe countries.
Local partners	Wood-processing Company "Jakic", Pljevlja

Project title: Ref. No. 16	**AFFORESTATION OF DEGRADED LAND**
Project description	The objective of the project is the afforestation of 360 ha of degraded agricultural and pasture land. The project area is located in the north region of the Republic, on the territory of the Municipality of Berane, along the riverside, in the area of the upper river course of the river Lim. Currently, the project area is classified as grassland, with vegetation cover that includes presence of shrubs. The terrain is exposed to the risk from erosion and therefore it is essential to establish a vegetative cover soon. It is planned to undertake the present carbon sequestration project trough afforestation of degraded land, which would lead to enhanced sources of livelihood and incomes in poor rural areas, reduced soil degradation, improved water quality and conservation of biodiversity. The forest species to be planted are determined according to the site and productive/protective scope of the plantation. Hence, the species selected are coniferous native species. Under the specific climate and site types of the land proposed for afforestation, the species mentioned above offer the best chance for the success of plantations with respect to local ecological benefits, wood supply, soil and site stabilization, and improvement of rural landscapes.
Applied methodology	***Carbon Sequestration Evaluation Model***
GHG offset	It is estimated that the project has a capacity to sequester around ***3.300*** tCO_{2eq} by the end of 2012, i.e. approximately ***4.800*** tCO_{2eq} by the end of 2017. During the crediting period of 30 years, the project could sequester around ***50.600*** tCO_{2eq}.
Sustainability	The following non-GHG related social and environmental benefits have been identified as a result of the project: • Support to the sustainable development of the local community and enhancement of sources of livelihood and incomes in the area • Protection of soil from erosion • Increment in forest cover • Biomass production • Reduction of air pollution in the urban area located in the vicinity of project area
Current status	Specific technical information through questionnaires and site visit have been collected and the local site owner agreed on the project implementation.
Estimated investment cost	Estimated cost for afforesting 360 ha of degraded agricultural and pasture land with coniferous native species has been estimated to be around 500.000 EUR.
Local partners	Directorate for Forestry of the Republic of Montenegro, Institut for Forestry, Podgorica.

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