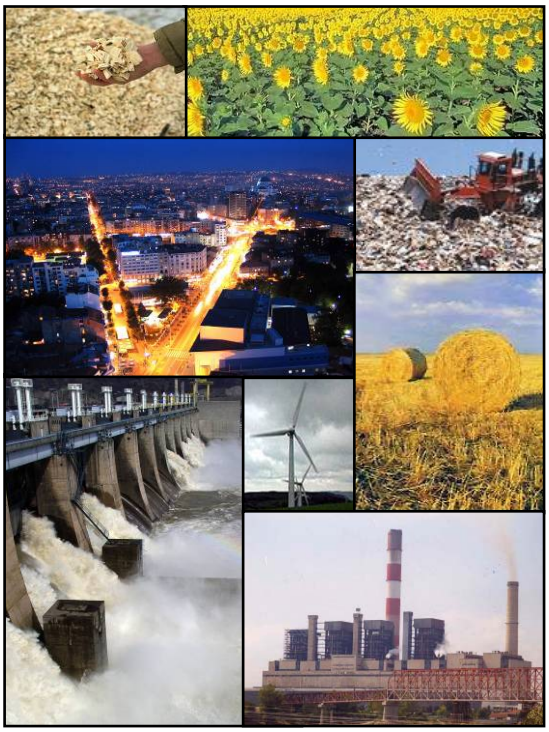
Italian Ministry for the Environment, Land and Sea
Department for Environmental Research and Development



ASSESSMENT OF THE PROJECTS' POTENTIAL IN THE FIELDS OF RENEWABLE ENERGY SOURCES, ENERGY EFFICIENCY AND FORESTRY MANAGEMENT, IN THE FRAMEWORK OF CLEAN DEVELOPMENT MECHANISM FORESEEN BY THE KYOTO PROTOCOL IN THE REPUBLIC OF SERBIA

May, 2007

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ABBREVIATIONS AND ACRONYMS

ACM	Approved Consolidated Methodology
AWMS	Animal Waste Management System
BOD	Biological Oxygen Demand
CDM	Clean Development Mechanism
CERs	Certified Emission Reductions
COD	Chemical Oxygen Demand
CoP	Conference of the Parties
DH	District Heating
DNA	Designated National Authority
DTDHS	Danube – Tisa – Danube hydro system
EE	Energy Efficiency
EPS	Electric Power Utility of Serbia
ESDS	Energy Sector Development Strategy
ET	Emissions Trading
ETS	Emission Trading Scheme
EU	European Union
GHG	Green House Gases
IMELS	Italian Ministry for the Environment, Land and Sea
JI	Joint Implementation
KP	Kyoto Protocol
LDCs	The least developed countries
LULUCF	Land-Use, Land-Use Change and Forestry
OECD	Organization for Economic Co-operation and Development
PPA	Power Purchase Agreement
SEEA	Serbian Energy Efficiency Agency
SHPP	Small Hydro Power Plant
TPP	Thermal Power Plant
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change

Introduction

The Kyoto Protocol is an international treaty aimed at contrasting climate change through stabilization of green house 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.

Reduction projects may take place within the countries Parties to the Protocol, which in turn may or may not have their own national reduction targets. In the case of countries having emissions target, credits are generated through the Joint Implementation (JI) flexible mechanism, while in the countries not having such targets (the case of Serbia and Montenegro), the credits are generated through the Clean Development Mechanism (CDM).

The 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 the selected sectors of the European Union. Similarly to the trading mechanisms developed by the Kyoto Protocol, companies may comply with such limits by either reducing their emissions, acquiring emission allowances from other companies, or acquiring carbon credits through the JI and CDM mechanisms.

The entry into force in the early 2005, of both the Kyoto Protocol and the EU ETS, has exponentially accelerated the carbon market activity aimed at trading carbon emission allowances and carbon credits. The possibility in the near future of using JI and CDM credits in the EU ETS 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, which have mobilised cross border international investment flows in energy 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 JI and CDM countries.

The Serbian- Italian Cooperation Programme

The State Union Serbia and Montenegro became officially a non – Annex 1 Party to the UNFCCC, in March 2001, as a successor of FRY (Federal Republic of Yugoslavia), which had accepted the UNFCCC back in 1997.

Aware of the importance of addressing climate change, and of the opportunities offered by the Clean Development Mechanism, Serbia has begun the process of ratification of the Kyoto Protocol and implementation of the CDM infrastructure.

The process is benefiting from an institutional exchange programme between Italy and the Republic of Serbia, launched in October 2004.

The programme aimed at sharing experience in the areas of:

- *Development of the legislative framework necessary for the Kyoto Protocol Ratification* - the framework had to reflect the federal structure of the government and the distribution of roles and responsibilities between the State Union and Republics levels
- *Implementation of the national inventory system for monitoring emissions of greenhouse gases* - the system will be both backward looking in tracing the historical development of the emission profiles as well as forward looking in forecasting future emission trends by sector
- *Preparation of the national communications on climate change required by the UNFCCC and Kyoto Protocol implementation* – the document will describe the characteristics of the economic system underlying recent emission trends as well as current and expected policies
- *Estimation of the carbon credit generation potential* – the analysis will focus 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 will define roles and responsibilities, as well as prepare the necessary regulatory proposals; more specifically, it will address both the organization and the rules of procedure of the Designated National Authority, the government entity responsible for CDM project approvals.

The Kyoto Protocol has already been approved by the Government of the Republic of Serbia; at the moment, its approval is expected at the session of the Assembly of the Republic of Serbia.

CDM carbon opportunities in the heart of Europe

The Republic of Serbia presents a unique opportunity in terms of carbon finance. The Kyoto Protocol rules provide it with the status of a potential CDM host nation. Such status represents an important competitive advantage compared to other Central and Eastern European Economies, which can generate carbon credits only through the Joint Implementation (JI) framework. The CDM procedure has two main advantages in respect to the JI procedure:

- *Existing validation framework* - the UNFCCC CDM Executive Board is already operational, while the JI Supervisory Committee has recently started to operate,
- *Early credit recantation* - CDM carbon credits can be generated as of the year 2000, while JI carbon credits will be generated starting from the year 2008.

In addition to the advantages associated with its CDM host status, the attractiveness of the Republic of Serbia to carbon credit generating opportunities is further reinforced by its favourable position in the heart of Europe, the quality of its industrial development context (skilled local resources and consolidated institutional setting) and an interesting carbon potential.

In the following paragraphs, the sector level potential is examined in more detail, while the next chapter looks at specific opportunities identified. The following table provides a summary of estimated carbon potentials per sector per year.

Table 1. Summary of carbon potentials

Sector	Sub-sector	Carbon potential per year, kt CO_2
Energy Saving potential per sectors	Industry	2.000
	Transport	2.800
	Building	6.500
	Others	1.200
	TOTAL	12.500[1]
Renewable Energy	Small Hydro	800
	Biomass	2.300[2]
	Solar	NA
	Wind	1.300
	Geothermal	650
	TOTAL	5.500
Waste Sector + Manure Treatment		410 + 800
LULUCF Sector		500
TOTAL		**~19.700**

As described in the Table 1. and in more details in the sections below, preliminary analysis estimates the aggregate carbon potential of the Republic of Serbia in the range of 20 Mt CO_{2eq} to 25 Mt CO_{2eq} per year. When valued at expected market prices ranging between 6 and 9 EUR/ton of CO_{2eq}, the resulting potential carbon investment can be expected to range between 120 million EUR and 225 million EUR per year. Even if quite preliminary, such initial estimates clearly indicate the potential contribution of carbon finance to the development of the Serbian economy in the short and medium term.

[1] Without energy savings potential in electricity generation, transmission and distribution

[2] Including agricultural residue, forestry and wood industry

ENERGY SECTOR

Introduction

In the process of harmonization of the national legislation with the EU requirements, the Ministry of Mining and Energy of the Republic of Serbia has prepared a reform of the energy sector, establishing a new legal, institutional and regulatory framework in order to create a more efficient energy market. The above reform is based on the Energy Law (2004)[3] and the Energy Sector Development Strategy by 2015 (ESDS)[4], adopted by the Government of the Republic of Serbia at the end of 2004, and approved by the Serbian Parliament in May, 2005. The ESDS has foreseen the development of the Program for the Implementation of the ESDS, focused on the main priorities: modernization of the existing power plants, rational utilization of the fossil fuel sources, utilization of the renewable energy sources and implementation of the clean technologies, as well as construction of the new power plants. Beside the latter, the ESDS identifies the implementation of the Kyoto Protocol as a useful tool in order to achieve the European standards on environmental protection. Therefore, the future steps in the energy sector in Serbia will be oriented towards resolving the problems related to:

- Requirement for large investments in the energy sector in order to improve and modernize the energy infrastructure,
- Unsustainable financial operation of energy supply companies due to energy prices not reflecting the actual production costs,
- Need to develop and implement a comprehensive policy designed to improve the energy efficiency and the utilisation of renewable energy sources,
- Low exploitation of the available potential of renewable energy sources,
- High energy consumption in buildings with large share of electricity use for space heating purposes,
- Low energy efficiency in industry with out-dated energy-intensive manufacturing technologies,
- Technically deteriorated, energy inefficient and polluting municipal energy supply services.

In parallel, the Ministry of Mining and Energy of the Republic of Serbia, in the field of legal and regulatory provisions, has been focused on:

- By-laws regarding to the Energy Law,
- Role of the Energy Regulatory Agency - a new independent agency, established in order to regulate the sector, which will improve governance and provide a framework for private investments in the sector; it became fully staffed and operational in the second half of 2005,
- Realisation of the Program for the implementation of the ESDS by 2015,

[3] Official Gazette of RS No.84/04.

[4] Official Gazette of RS No.44/05.

- Restructuring of the Serbian Electricity Sector.

The electricity generation in Serbia is in hands of the state company the Electric Power Utility of Serbia (EPS) possessing the capacities presented in the Table 2.

Table 2. The plants owned by EPS

Plants	Installed net capacities	
	MW	%
Thermal power plants	3.936	55,3
Thermal power-heating plants	353	5,0
Hydropower plants	2.831	39,7
TOTAL	**7.120**	**100,0**

New hydro power plants (e.g. Brodarevo, Ribarici, Vrutci, SHPPs etc.), new thermal power plants (TPP Kolubara B, TPP Nikola Tesla B3) and the refurbishment and/or new construction of lignite open-pit mines (Tamnava - Zapadno Polje and Drmno) are planned. For example, the assessment done has shown that the rehabilitation and modernisation of the existing hydroplants will result in increasing the total installed capacity by 128 MW or in generated electricity app. 247,5 GWh /7/.

The economic recovery of Serbia and its increasing energy production requirements bring important investment opportunities. The private sector is immediately encouraged to invest in gas distribution, and in power generation segments, as well as in projects such as the natural gas retail distribution network, the main gas pipeline Nis-Dimitrovgrad, and the underground gas storage facilities. In parallel, the energy efficiency in industry, building and transport demonstrates also an interesting potential.

Energy savings potential

The current energy efficiency is generally poor in all sectors. The main reason for this is ignorance, the use of obsolete equipment and lack of finances for investments in modern, efficient technology. Within the scope of the Program for the implementation of the ESDS, the energy efficiency measures in relevant sectors have been defined. By the implementation of the mentioned measures in the power, industrial, building and transport sectors, the significant energy savings could be reached, resulting in high amount of GHG emission reductions.

The assessment done in the Economic Development Strategy foresees the annual economic growth, according to conservative and basic scenarios, in the value of 5 % and 7 %, respectively. The energy consumption in industrial sector will grow up with the economic development, too and estimated value is app. 5 % without implementation of any energy efficiency measures.

The Serbian industrial sector is the largest sector of the national economy, accounting for about 43 % of GDP (in 2001) and it poses serious challenges for the development of both, energy supply and energy demand. According to the national statistics, during 2002, there were 1980 active

industrial companies in the Serbian industry, excluding Electric Power Industry of Serbia, which comprised 91 active industrial companies. These 1980 active companies were divided into 467 small, 862 medium and 651 large industrial companies, with the total energy consumption of 2.500.000 tons of oil equivalent.

The most energy intensive industrial sectors are: Chemical Industry (energy consumption share in 2002 was 21 %), Industry of Building Materials (17,4 %), Black Metallurgy (16,2 %) and Food Industry (14,8 %), followed by Industry of Energetic (8,7 %), Industry of Non-Metals (4,7 %) and Pulp & Paper Industry (3,6 %). An additional illustration of the actual unsatisfactory energy efficiency situation/trend in the Serbian industry is the comparison of the average energy intensity (in kg of oil equivalent per $US of GDP) for the world industry (0,19 kgoe/$US) and for the Serbian industry (0,54 kgoe/$US).

Considering industrial sector, the following energy efficiency measures could be applied: optimisation of the combustion processes (~ 940 GWh), increase of the efficiency of the existing boilers, modernisation of the control and regulatory systems of the industrial processes (~ 1.880 GWh), re-use of the waste heat from the processes, the change of the existing electric engines (~ 188 GWh) etc. /7/

In the building sector in Serbia, by the implementation of the measures such as: use of renewable energy in the district heating systems (~ 1.500 GWh), thermal isolation of the buildings walls (~ 3.500 GWh), change the existing lighting systems with more efficient ones (~ 701 GWh), as well as the windows in the households and public buildings (~ 7.400 GWh), the total energy saving could reach the annual value of approx. 13.000 GWh /7/.

Based on the existing assessment of the energy efficiency levels, and assuming the possibility for the Serbian economy to reduce the existing gap with the world average energy efficiency performance by 50 %, a potential generation for credits through energy savings in the above-mentioned sectors can be estimated at approximately 12,5 MtCO_2/year.

Renewable energy potential

The potential development of renewable energy sources in the Republic of Serbia appears to be quite interesting. Assuming average world load factors for the various types of generation technology, as well as an approximate opportunity, the capture rate is between 40 and 60%, and the additional power production potential ranges between 8 and 12 TWh/year. Based on the current specific emissions in the electricity sector, the resulting potential carbon savings range between 5 and 8 Mt CO_{2eq}/year.

Hydro energy

In terms of hydroelectric potential, technically useful potential of hydro energy in Serbia is approximately 19,8 TWh/year, where 18 TWh/year is deriving from plants with the installed capacity above 10 MW, while the remaining 1,8 TWh/year is associated with SHPPs. According to the existing cadastre of SHPPs in Serbia, there are more than 850 SHPPs locations, with the total installed

capacity of app. 450 MW and possible annual electricity generation of 1.600 GWh. Today, large hydro power plants produce around 10,3 TWh/year of electricity, which is approximately 32 % of the total annual electricity production in Serbia. Due to the lacking fossil resources, this percentage has to be increased.

Biomass

In regard to the energy from biomass, Serbia without Kosovo and Metohija has the surface of 77.474 km^2, with 31% covered with forests and 58% under cultivation. Around 2,9 million m^3 of forest wood is being harvested annually. The total energy potential of all biomass residues, including firewood, has been estimated to be 115.700 TJ/year:

- 65.000 TJ/year of agricultural cultivations residues (it represents approximately 30 % of the total residues in agriculture);
- 25.000 TJ/year from residues in fruit and wine growing;
- 25.700 TJ/year in forestry and wood industry.

Utilization of the total amount of biomass residues could substitute 30% of annual coal consumption in the country, i.e. 70% of annual residual fuel oil consumption. However, energy potential of the biomass not currently used for energy or other purposes, like for fodder, covers in stables, industry needs, or food industry, accounts for over 70.000 TJ/year which could be transferred to annual power production of approximately 5,5 TWh/year /3/.

Wind energy

Another important potential source of renewable energy is wind. According to the global practice, the wind with the average annual velocity above 5 m/s, calculated from the ten minutes average speeds at the height of 50 m above the see level, is necessary in order to obtain a cost-effective electricity production with modern wind generators. According to this criterion, it has been shown that Serbia has a significant wind energy potential. The surface with suitable wind covers 471,25 km^2. It has been estimated that the most favorable locations are: Midžor (7,66 m/s), Suva Planina (6,46 m/s), Vršački Breg (6,27 m/s), Tupižnica (6,25 m/s) and Krepoljin (6,18 m/s). Numerous locations spread over the total area of 244 km^2 are identified, where more than 50% of the time during the year the winds blow with the average speed above 6 m/s. Preliminary analysis indicates that the wind potential in Serbia, including the zones with the average speed above 5 m/s, amounts to approximately 1.316 MW of the installed capacity, that is approximately 15% of the total electric power capacities in Serbia. Potential additional wind power generation development could lead to additional production in the range of 3 TWh/year /5/.

Geothermal energy

Finally, the Republic of Serbia provides important potential for geothermal energy. Exploration carried out to-date has shown that geothermal energy use in Serbia for power generation can provide a significant component of the national energy balance. The territory of Serbia has favourable

geothermal characteristics. There are four geothermal provinces. The most prospective are the Pannonian and Neogen magmatic activation provinces. More than eighty low enthalpy hydro-geothermal systems are present in Serbia. The most important are located at the southern edge of the Pannonian Basin. The reservoirs of these systems are in karstified Mesozoic limestone with a thickness of more than 500 m. The resources of geothermal energy in Serbia have been estimated to approximately 600 Mtoe. The research of geothermal energy in Vojvodina, and today also in other regions, has been organized by the NIS-Naftagas company. Out of the 112 hydro-thermal, oil and gas pools existing in Vojvodina, only 24 pools are currently used.

The entire installed capacity of all constructed geothermal systems amount to approximately 23 MW, with the savings of approximately 5.000 t of crude petroleum per year. However, the real geothermal energy potential is considerably greater, since approximately only 9 % of it is used from the available capacity. In such respect, potential further development of geothermal energy sources could lead to additional production of 1,5 TWh/year.

WASTE SECTOR

Municipal Solid Waste

General state of waste management in Serbia is inadequate, and it poses public health and environmental hazards. The most acute problem is represented by the hazardous waste, which is not separately collected and is dumped without processing on regular waste dumps. Uncontained and untreated leachate from waste dumps contaminates aquifers and surface waters.

Only about 60 – 70 % of municipal solid waste is collected in Serbia (around 2,2 million m^3 per day). The collection is organized in urban areas, while an organized collection is lacking in rural areas. Part of the waste generated in the rural areas is used in backyard burning. The average person generates approximately 290 kg of waste per annum. Households generate the majority of municipal waste (about 63 %), and 20 % is generated by businesses. At present, there are 180 officially registered landfills for disposal of municipal waste in Serbia. The disposal sites generally fail to meet the technical requirements of sanitary landfills. There are also hundreds of illegal dumpsites of different size in the rural areas. Dumpsites are subject to uncontrolled burning producing harmful emissions of particulate matter, dioxins and PAH. Degradation of biodegradable waste in dump sites results in the discharge of landfill gas, containing carbon dioxide and methane, which may, due to inadequate handling, lead to explosions. The leachate from dumpsites is a threat to groundwater, surface waters and soil due to the high organic and heavy metals load.

It is difficult to assess the carbon potential of improved waste management because of the variability of the potential carbon savings. According to the data available from the Waste Management Strategy of SCG, total amount of MSW that is disposed to registered disposal sites in Serbia is app. 2,2 Mt (in 2003). By the conservative approach, the potential carbon savings from the sector could be estimated at 410 $ktCO_2$/per annum.

Legislation which regulates solid waste management in Serbia does exist, but it is either not in compliance with the EU legislation, or some laws are not properly enforced.

Relevant regulations in the field of solid waste management and GHG emission reduction in the Republic of Serbia are:

- Law on Environmental Protection (Official Gazette of RS No. 135/04);
- Law on Integrated Pollution Prevention and Control (Official Gazette of RS No. 135/04);
- Law on Handling of Waste Materials (Official Gazette of RS No. 25/96);
- Regulation on threshold values, emission measuring methods, selection of sampling locations criteria and data registering (Official Gazette of RS No. 54/92, 30/99);
- Regulation on emission threshold values, methods and timeframe for measurement and data registering (Official Gazette of RS, No. 30/97, 35/97);

- Regulations on the criteria for determining location and disposition of waste disposal sites (Official Gazette of RS, No. 54/92). This regulation is not entirely harmonized with the EU Directive 1999/31/EC on disposal sites, amongst other issues, due to legally undefined requirement for the landfill gas treatment and utilization system.
- Regulation on conditions of secondary raw materials' classification, packaging and storage, (Official Gazette of RS, No. 55/01).

Sectoral Law on waste management is still in the drafting phase, along with the Law on package waste. Draft Law on waste management provides for waste characterization harmonized with EU standards, preparation of Regional, Local SWM Plans and SWM Plans for waste management facilities, obligations for waste utilization, suggestion for biological treatment in order to reduce GHG emissions, thermal waste treatment with energy recuperation, landfill types, etc. It also defines the permitting system for waste management.

Manure management

Livestock farming is a traditional production activity in Serbia, usually taking place on farms, mostly combining livestock with crop production. Generally, the farms could be divided into two groups: large scale pig farms and dairy operations (treating about 80% of total swine population in Serbia) and medium and small scale private pig farms. Despite a long tradition, the farms are very often they economically weak, lacking financial resources and equipment.

Manure management sector counts for CH_4 and N_2O emissions. The emissions from the sector are dependant on the type of manure management system and the number of animals (Table 3).

Table 3. Number of animals (in 1000's) in the period 1999-2004 /7/

	1999	2000	2001	2002	2003	2004
Cattle	1.283	1.246	1.162	1.128	1.112	1.102
Swine	4.293	4.066	3.615	3.587	3.634	3.439
Sheep	1.598	1.611	1.489	1.448	1.516	1.586
Goats	193	183	180	164	169	155
Horses	43	37	30	29	24	26
Poultry	23.278	20.373	19.290	18.804	17.677	16.280

Generally speaking, cattle manure is usually recycled on crops. Nevertheless, environmental issues certainly exist, related to poor storage facilities. The majority of farms have a piece of land or concrete platform on which the solid manure is piled, exposed to the rain, with no recollection of the liquids resulting from lixiviation. In addition, the drainage canals collecting the farms' rainwater and wastewater were often directly discharging into the environment.

Furthermore, general survey indicated the liquid treatment as a common practice with swine manure on large scale pig farms in Serbia. According to the data available /8/ these kinds of pig farms

in Vojvodina produce an average of 23.000 pigs per year (within a range of 10.000 to 98.000 heads).In this case, the effluent is slurry, which is discharged into lagoons that overflow into canals or small natural streams. Despite the fact that some of the farms have manure management system, it is often not anymore in operation, due to associated running and maintenance costs.

In case of medium and small pig farms, (producing of about 500 to 2.000 fattened pigs per year), the most of swine manure is recycled on crops. Limited storage capacity also results in inadequate application periods and quantity: basically the farmers empty the tank on the fields when it is full, not taking into consideration the weather and the crops requirements. An overview of the total swine population in Serbia is given in Table 4.

Table 4. Swine population, in thousands of heads /7/

	1999	2000	2001	2002	2003	2004
Suckling pigs under 2 month	1.234	1.174	1.070	984	1.021	1.125
Pigs from 2 to 6 months	1.766	1.603	1.400	1.434	1.433	1.300
Sows and sows of first farrow	896	887	790	817	825	692
Breeding boars	26	25	37	49	44	40
Other pigs	370	377	317	304	310	283
TOTAL	**4.293**	**4.066**	**3.615**	**3.587**	**3.634**	**3.439**

Environmental issues in this sector are related to direct emission of methane from lagoons into air, discharge of waste water from lagoons into watercourses, manure seepage from storage tanks and lagoons causing ground water pollution.

With respect to air pollution, potential carbon savings from swine manure management sector, taking into consideration only CH_4 emissions from liquid manure treatment systems, may be estimated at 800 $ktCO_2$/per annum.

FORESTRY SECTOR

Forests cover 2.412.940 hectares, or 26,7 % of the total area of Serbia. This is estimated to be about 65 % of the optimal forest cover. The State owns 51,5 % of the forests. The remaining 48,5 % is in private ownership. Private forest areas are very fragmented and it is difficult to manage such small and fragmented forests on a sustainable basis. Up to the late 1980s some 400.000 hectares of state land were reforested. Currently, only 2.000 – 2.500 hectares are being planted annually. It is estimated that some 200.000 hectares of state-owned land need to be reforested. In addition, the Ministry for Agriculture, Forestry and Water Management of Serbia is considering reforestation of some 1,3 million hectares of vacant and abandoned agricultural land in the long term.

National legislation in the forestry sector in Serbia:

- Law on Forestry (1991)
- Law on the Environmental Protection (2004)
- Law on Hunting (1993)
- Law on Agricultural Land (1992)
- Law on National Parks (1993)
- Act on Protection of Natural Rarities, 1993
- Spatial Plan of the Republic of Serbia, 2000
- Forest development plan to the year 2050 (prepared in 1996)

The 10 – year Spatial Plan of the Republic of Serbia to the year 2010 states the basic goals of the forestry sector as organizing and utilizing forests and forestland to improve the state of forests and to increase the areas covered by forests primarily in the Province of Vojvodina. Organizing and increasing forest areas around larger cities have been identified as a priority, in order to improve the environmental situation and prevent uncontrolled expansion of urban areas. The two main forest management types in Serbia are intensive management of even-aged stands and plantations (in ordered rotations) in Vojvodina and other lowlands, and combined management of selection hill and mountain forests, with a high share of protective functions.

Current information and the need for further consolidation at the UNFCCC level of the sinks in CDM project validation procedures do not allow a quantified assessment of the carbon potential associated with forestry in the Republic of Serbia. Nevertheless, the possibility of generating additional environmental services and benefits, such as flood and salinity control and biodiversity preservation, make forestry a very interesting option for carbon savings.

Specific credit generating project opportunities

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

SUMMARY TABLE				
	PROJECT TITLE	REDUCTION [tCO_{2eq}] 2008 – 2018	PARTNERS	STATUS
WASTE HANDLING AND DISPOSAL				
1	**NOVI SAD – DUMP SITE LFG RECOVERY AND FLARING**	**251.000**	City of Novi Sad, Public Utility Company "Cistoca"	Prefeasibility
2	**KRAGUJEVAC – DUMP SITE LFG RECOVERY AND FLARING**	**110.000**	City of Kragujevac, Public Utility Company "Cistoca"	Prefeasibility
3	**KIKINDA – DUMP SITE LFG RECOVERY AND FLARING**	**32.000**	Municipality of Kikinda, Local Public Utility Company	Prefeasibility
4	**BUNDLED PROJECT ACTIVITY - GHG EMISSIONS REDUCTION THROUGH LFG FLARING**	**140.000**	Municipality of Uzice, Cacak and Pozega, Local Public Utilities	Prefeasibility
5	**KRALJEVO DUMP SITE - LFG RECOVERY AND FLARING**	**90.000**	Municipality of Kraljevo, Local Public Utility Company	Prefeasibility
6	**NIS – DUMP SITE LFG RECOVERY AND USE**	**386.000**	City of Nis, Local Public Utility Company	Prefeasibility

ANIMAL WASTE MANAGEMENT SYSTEMS – MANURE TREATMENT				
7	**AWMS METHANE RECOVERY PROJECT FOR THE FARM „DRAGAN MARKOVIC“ OBRENOVAC**	**84.000**	Company “Dragan Markovic A.D.”	Prefeasibility
8	**AWMS METHANE RECOVERY PROJECT – PKB BELGRADE BULL FARM UNIT “NOVA CETVORKA”**	**52.000**	Public company “P.K.B” Belgrade	Prefeasibility
9	**AWMS METHANE RECOVERY PROJECT – PTK “PANONIJA” FROM BACKA TOPOLA**	**112.000**	Company PTK “Panonija AD”	Prefeasibility
10	**AWMS METHANE RECOVERY PROJECT – PP “POBEDA” FROM BACKA TOPOLA**	**84.000**	Company PP “Pobeda”	Prefeasibility
11	**AWMS METHANE RECOVERY PROJECT FOR THE FARM “STARI TAMIS”, PANČEVO**	**115.000**	Company “Stari Tamis”	Prefeasibility
12	**METHANE CAPTURE AT DISTILLERY “ALPIS”, KOVIN**	**160.000**	Company “Alpis”	Prefeasibility
RENEWABLE ENERGY				
13	**SHPP VRGUDINAC, SHPP CRVENI BREG, SHPP MALA BELA PALANKA (*Bundling project*)**	**300.000**	Municipality of Bela Palanka	Prefeasibility
14	**BUNDLED PROJECT ON DTD HYDRO SYSTEM**	**226.000-296.000**	Secretariat for Energy and Mineral Resources of the AP Vojvodina	Prefeasibility

15	**BIOMASS FOR ENERGY PROJECT**	**160.000**	Municipality Ivanjica	Prefeasibility
16	**AWMS METHANE UTILIZATION PROJECT – PIK "BECEJ"**	**600.000**	Company PIK Becej	Prefeasibility
17	**WIND ENERGY USE IN CENTRAL SERBIA**	**460.000**	EPS	Prefeasibility
	ENERGY EFFICIENCY			
18	**HIP-AZOTARA IN PANCEVO: INTERVENTIONS FOR ENERGY EFFICIENCY IMPROVEMENTS**	**300.000**	HIP AZOTARA	• Prefeasibility study completed • Feasibility Study expected to be issued on June 07 (business plan included)
19	**JKP GREJANJE DISTRICT HEATING IN PANCEVO: COMBINED HEAT AND POWER (CHP) PLANT**	**600.000**	JKP - GREJANJE	• Prefeasibility study of the CHP completed • Feasibility Study for CHP plant is expected to be issued on June '07 (business plan included)
20	**ENERGY EFFICIENCY IN STREET LIGHTING – CENTRAL SERBIA**	**60.000**	Municipalities of Cacak, Ivanjica, Uzice, and Pozega	Prefeasibility
21	**ENERGY EFFICIENCY IN STREET LIGHTING – CITY OF NIS**	**18.000**	City of Nis	Prefeasibility
22	**COGENERATION PLANTS IN INDUSTRIAL ZONE IN CACAK**	**100.000**	Factory Sladara, Factory FRA, Factory " Bozo Tomic", and Municipality of Cacak	Prefeasibility
	FUEL SWITCH			
23	**AFFORESTATION AND WOOD BIOMASS UTILIZATION IN THE SPECIAL RESERVE OF NATURE**	**167.000**	Public Company for Forest Management "Vojvodinasume"	Prefeasibility

CARBON SEQUESTRATION				
24	**ESTABLISHMENT OF THE FOREST WIND BELTS FOR AGRICULTURE LAND**	**36.000**	Municipality of Kikinda	Project concept

Project title *Ref. No. 1*	**NOVI SAD – DUMP SITE LFG RECOVERY AND FLARING**
Project description	The objective of the project is improvement of the LFG management system on a dump site serving the City of Novi Sad, in order to find environmentally friendly solution to reduce current LFG release into the atmosphere. The project would be composed of LFG collection and flaring, thus converting its methane content into CO_2 and simultaneously reducing its GHG effect. The CDM project baseline scenario could be the "continuation with the current situation". The project baseline emissions will be the amount of methane that would be emitted from the dump site to the atmosphere during the crediting period, in case there is no CDM project activity. The dump site is situated at the north-west side of the settlement and has been operational since 1960's. Over 1,2 Mt of waste has been disposed at the site so far. The dump site receives all collected MSW of the city of Novi Sad and the surrounding settlements, with a population of approximately 300.000 inhabitants. The amount of MSW carried into the dump site is estimated at 300 t/day. A separation line for secondary raw materials such as plastic, glass, metal and paper was established at the site in 2002, in order to decrease the amount of waste for final disposal and to extend the lifetime of the dump site. The separation residue with high organic content is balled and afterwards disposed at the landfill. Before the separation line was constructed, all collected waste was directly spread out over the landfill, but after the construction, only 30% of total collected waste is directly spread.  The operator of the dump site, the Public Utility Company "JP Cistoca", due to investment and technological barriers, is not able to collect and flare LFG. The legislation requiring compulsory recovery, collection and flaring of the LFG from dump /landfill sites does not exist, neither in the regulatory framework of the Municipality Novi Sad nor in the Republic of Serbia. The only requirement is to vent the LFG 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 emissions only through flaring of LFG of approx. ***251.000*** tCO_{2eq} for the period 2008 - 2018.
Sustainability	Common benefit of the project would be a contribution to the mitigation of global warming through reduction of methane emissions to the atmosphere. Beside regular activities regarding the reduction of GHG, the project itself recognizes non-GHG related environmental benefits identified at the local level, such as:

	• Dump site odour prevention • Dump site fire prevention • Effect in terms of enhancing human resources through introducing new technology • Employment creation effect through project realisation
Current status	Specific technical information have been collected through questionnaires and site visits and the local site owner agrees on the project implementation
Estimated investment cost	Around 700.000 € (including suction cost, collection cost, flaring cost, engineering cost and CDM cost)
Local partners	City of Novi Sad, Public Utility Company "JP Cistoca"

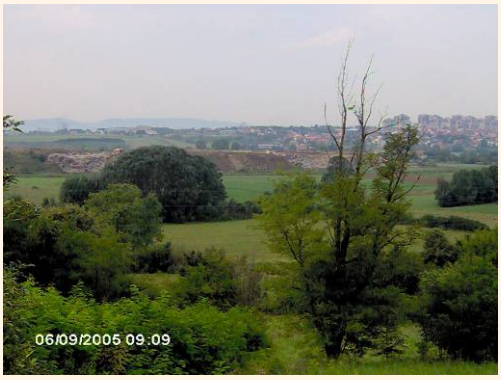
Project title *Ref. No. 2*	**KRAGUJEVAC – DUMP SITE LFG RECOVERY AND FLARING**

Project description

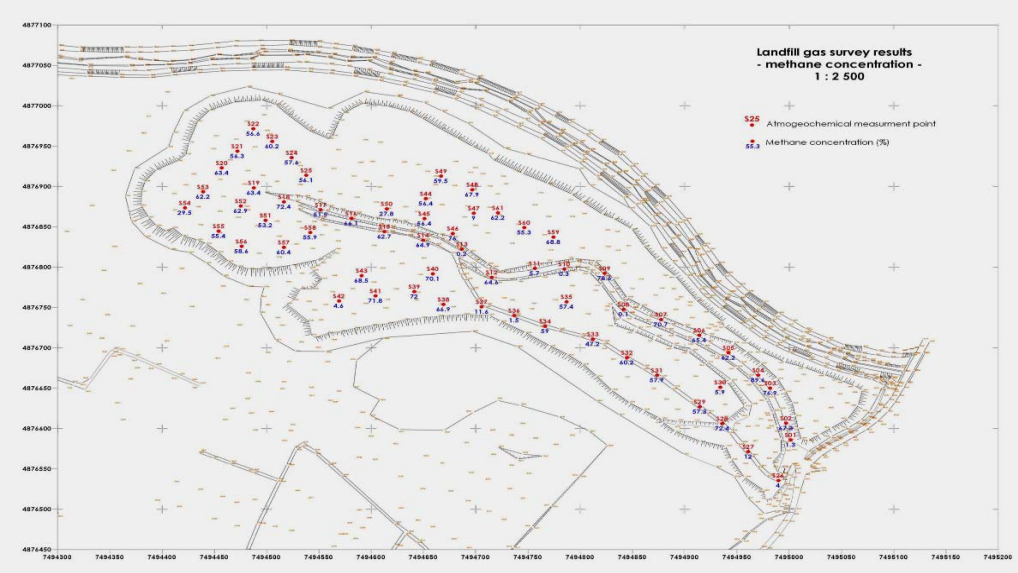
The main project objective is the reduction of current methane emission from the dump site "Jovanovac". Following the project concept, LFG have to be recovered, collected and combusted on the dump site. This will involve investments in LFG recovery, collection and flaring technology. In that manner, through combustion of methane gas content in recovered and collected LFG, significant GHG emission reduction will be achieved.

The CDM project baseline scenario could be the "continuation with the current situation". The project baseline emissions will be the amount of methane that would be emitted from the dump site to the atmosphere during the crediting period, in case there is no CDM project.

This dump site "Jovanovac" is located in the vicinity of the City of Kragujevac. It has been operational since 1963. The dump site receives all collected MSW of the Kragujevac Municipality, serving a population of approximately 129.000 inhabitants. The amount of MSW carried into the landfill is estimated at 96 t/day. Until today, over 2 million tons of MSW have been disposed at the dump site (see the picture below).



Waste dumping is practically the only way of MSW management without any previous treatment in terms of environmental protection. The above disposal site has no system to protect groundwater against leaching. Currently, vertical wells for LFG venting cover around 20% of the dump site area showing rather large percentage of CH_4 in LFG; however, in the absence of a gas collection and flaring system, LFG is currently released to the atmosphere (see the map with LFG survey results).



	The operator of the dump site, Public Utility Company of Kragujevac "JP Cistoca", has no means to manage, control or collect LFG, due to investment and technological barriers. The legislation requiring compulsory recovery, collection and flaring or utilization of the LFG from MSW disposal sites does not exist, neither in the legal framework of the Municipality Kragujevac nor in the Republic of Serbia. The only existing requirement is to vent the LFG in order to avoid the explosion risk.
Applied methodology	AMS - III. G. – ***"Landfill methane recovery"***
GHG offset	It is estimated that the project has the capacity to reduce methane emissions of ***110.000*** tCO_{2eq} for the period 2008 - 2018.
Sustainability	Globally, the above mentioned project would contribute to GHG emissions reduction, by mitigating uncontrolled emissions of landfill gas to the atmosphere, as well as to the reduction of fossil fuel usage, by generation of electricity through LFG use. The uncontrolled release of landfill gas poses certain explosion risks and has a negative impact to the local environment and population health in the surrounding area. By proper management of the landfill site, the above risks and impacts would be significantly reduced. Likewise, the contaminated leachate and surface runoff from landfills may adversely affect ground and surface water quality, impacting the local environment. Therefore, at the local level, from a social and environmental point of view, this project would have a positive effect on health and general welfare in the area.
Current status	Specific technical information have been collected through questionnaires and site visits and the local site owner agrees on the project implementation
Estimated investment cost	Around 500.000 € (including suction cost, collection cost, flaring cost, engineering cost and CDM cost)
Local partners	Municipality of Kragujevac and Public Utility Company "Cistoca"

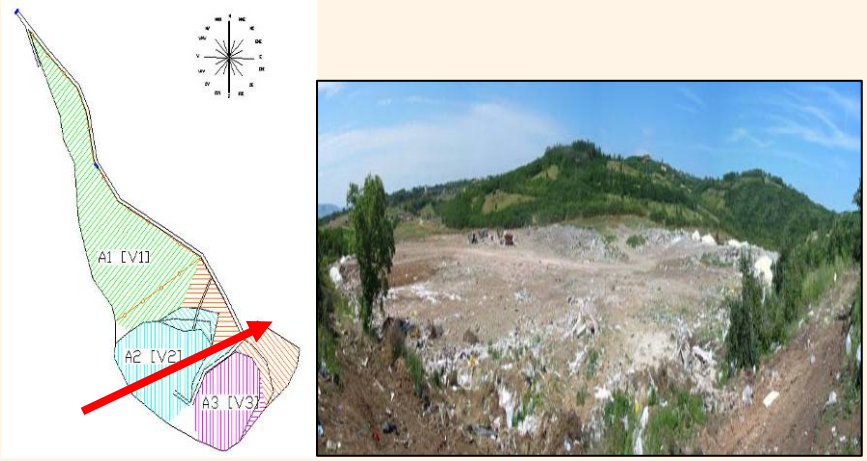
Project title Ref. No. 3	**KIKINDA DUMP SITE LFG CAPTURE AND FLARING**
Project description	The objective of the project is methane emissions reduction. LFG will be captured and its methane content through flaring converted into, with respect to global warming, less potent carbon dioxide. This will involve investing in gas suction and collection systems, blowers and a flaring system. The CDM project baseline scenario could be the "continuation with the current situation". The project baseline emissions will be the amount of methane that would be emitted from the dump site to the atmosphere during the crediting period, in case there is no CDM project The dump site has been operational since 1985, and over 340.000 tons of waste have been placed at the site. The dumping is practically the only way of MSW management without any previous treatment of MSW in terms of environmental protection. This disposal site has no system to protect groundwater against leaching of hazardous substances. Currently, the Municipality of Kikinda is planning a remediation project of the dump site with out the setting up of a collection and flaring system for LFG. The legislation requiring compulsory collection of LFG from dump/landfill sites does not exist, neither in the Republic of Serbia nor in the Municipality of Kikinda.
Applied methodology	AMS III. G. – ***"Landfill methane recovery"***
GHG offset	It is estimated that the project has the capacity to reduce emissions of nearly ***32.000*** tCO_{2eq} for the period 2008 - 2018.
Sustainability	The main social and environmental impacts of the project would be represented by a positive effect on health and general welfare in the local area. The uncontrolled release of landfill gas may pose explosion risks, and it may also have adverse effect on the population health and the local environment. By managing the landfill site properly, the environmental and health risks, as well as explosion risks, would be considerably reduced. The project will also have a minor, but positive, impact on the employment in the local area, through recruitment of staff engaged on the operation and maintenance of the landfill site.
Current status	Specific technical information have been collected through questionnaires and site visits and the local site owner agrees on the project implementation
Estimated investment cost	Around 300.000 € (including suction cost, collection cost, flaring cost, engineering cost and CDM cost)
Local partners	Municipality and Local Public Utility Company

Project title *Ref. No. 4*	**BUNDLED PROJECT ACTIVITY - GHG EMISSIONS REDUCTION THROUGH LFG FLARING**
Project description	The CDM project activity involves bundling of three dump sites in order to give an added value to the envisaged procedure of the environmentally sound closure of the dump sites. Currently, the closing procedure envisages only covering with a soil layer, leaving the possibility to consider other measures depending on waste and landfill characteristics. The added value of the project refers to enabling LFG collection and flaring at the sites. Through flaring, the methane is converted into CO_2 and hence, the greenhouse gas effect is reduced. This project activity would involve investments in gas collection systems and equipment for methane flaring. The project will also reduce environmental risks for the residents in the vicinity of the existing disposal sites. Bundled dump sites are situated in Central Serbia, of which Uzice and Pozega in Zlatibor District, and CaCak in the Morava District. As the above mentioned municipalities together with 6 other municipalities in the Zlatibor District agreed to found a new regional sanitary landfill, the existing dump sites should be put out of operation within next three years. **The dump site in Uzice** has been operational since 1977 and covers 8 ha. Over 350.000 tons of waste has been disposed at the site so far. During recent years, annual waste acceptance was around 18.000 t/year. **The dump site in Pozega** has been operational since 1976 and covers 6,5 ha. Over 200.000 tons of waste has been disposed at the site so far, while the average amount of waste disposed at the site is app. 8.400 t/year. **The dump site in Cacak** has been operational since 1977 and covers 22 ha. Over 510.000 tons of waste has been disposed at the site with annual waste acceptance of 22.400 t/year. The survey of the dump sites shows that none of the sites meet standards for sanitary landfills. There is no any previous treatment of MSW in terms of environmental protection or implemented measures for the protection of environment at the dump sites. At none of the sites, a weighbridge is installed. The disposal sites have no system to protect groundwater against leaching of hazardous substances. At the same time, monitoring of leachate generation, groundwater and surface water quality, is not carried out. In the absence of gas collection system, LFG is currently released to the atmosphere. Even though the Feasibility Study for Regional Landfill "Duboko" envisages closing of the above mentioned dump sites in an environmentally sound manner within next three years, there is a possibility that the lack of financial resources at the local level will postpone planed activities. In the light of the mentioned situation, it might be concluded that the project baseline scenario is the LFG released into atmosphere. Following the same approach, the baseline emission would be the amount of methane that would be emitted from the dump sites into the atmosphere during the crediting period, in the absence of the CDM project activity. The legislation requiring compulsory collection of LFG from landfill sites does not exist either in the Republic of Serbia or at the level of local self-governance.
Applied methodology	AMS III. G.– ***"Landfill methane recovery"***
GHG offset	It is estimated that the project has the capacity to reduce emissions through flaring of captured landfill gas of nearly ***140.000*** tCO_{2eq} in total for the period 2008-2018 or given split to

	each dump site 52.000 tCO_{2eq} in Uzice, 24.000 tCO_{2eq} in Pozega and 64.000 tCO_{2eq} in Cacak.
Sustainability	This project has a positive impact on the environment, in particular with regard to the mitigation of global climate change and local environmental sustainability.
Estimated investment cost CDM potential	Around 1.000.000 € (including suction, collection and flaring costs, engineering cost and CDM cost)
Current status	Specific technical information have been collected through questionnaires and site visits and the local site owner agrees on the project implementation
Local partners	Municipalities of Uzice, Pozega and Cacak and Local Public Utility Companies

Project title Ref. No. 5	**KRALJEVO DUMP SITE - LFG RECOVERY AND FLARING**
Project description	The objective of this project is to generate GHG emission reduction by construction of the system for LGF recovery, collection and its destruction through flaring. Through the flaring, of the LGF its methane content will be converted into CO_2. . The CDM project baseline scenario could be the "continuation with the current situation". The project baseline emissions will be the amount of methane that would be emitted from the dump site to the atmosphere during the crediting period, in case there is no CDM project Dump site "Kulagica Ada" is located in the vicinity of Kraljevo settlement and it has been operational since 1970. Dump site receives almost all MSW of the Municipality of Kraljevo with the population of approximately 85.000 inhabitants. The amount of MSW carried into the dump site is estimated at 88 t/day.[5] Almost all amount of waste going to the dumpsite site is composed of domestic waste. Dump site do not fulfil any minimal environmental protection measures. As there is no gas recovery and collection system, LFG currently escapes to the atmosphere. The user of the dump site, Public Utility Company "JP Cistoca" Kraljevo, has no means to manage, control or collect LFG due to investment and technological barriers. Legislation requiring the compulsory collection of LFG from landfill sites does not exist either in the legal framework of the Republic of Serbia or in the Kraljevo Municipality. The only requirement is to vent the LFG in order to avoid the explosion risk.
Applied methodology	AMS-III.G – ***"Landfill methane recovery"***
GHG offset	It is estimated that the project has the capacity to reduce GHG emission of nearly ***90.000*** tCO_{2eq} for the time period 2008 - 2018.
Sustainability	• Main social and environmental impacts of this project will be a positive effect on health and amenity in the local area • The project would also have a minor, however positive, impact on the employment in the local area, through recruitment of staff engaged on the operation and maintenance of the dumpsite
Current status	Specific technical information have been collected through questionnaires and site visits and the local site owner agrees on the project implementation
Estimated investment cost	Around 400 000 € (including suction, collection and flaring costs, engineering cost and CDM cost)
Local partners	Municipality of Kraljevo and Public Utility Company

[5] Data provided by the Public Utility "JP Cistoca" Kraljevo

Project title: Ref. No. 6	**NIS – DUMP SITE LFG RECOVERY**
Project description	The main project objective is the reduction of current methane emission from the dump site. The project will recover and combust LFG to generate electricity. Utilisation of LFG will convert the methane content to less potent carbon dioxide in terms of global warming. The CDM project baseline scenario could be the "continuation with the current situation". The project baseline emissions will be the amount of methane that would be emitted from the dump site to the atmosphere during the crediting period, in case there is no CDM project. The project concept requires investment in equipment for the LFG recovery, collection, and in a modular electricity generation plant, with the final capacity of 1 MW, in order to flare and/or produce electricity for grid supply. The dump site is located in the vicinity of the City of Nis. It has been operational since 1970's, and over 1,5 Mt of waste has been disposed at the site until now. The dump site receives all collected MSW of the Nis Municipality, which has a population of approximately 250.000 inhabitants. The amount of the MSW carried into the dump site is estimated at 278 t/day. The dumping is practically the only way of MSW management without any previous treatment of MSW in terms of environmental protection. This disposal site has no system to protect groundwater against leaching of hazardous substances. In the absence of a gas collection system, LFG is currently released to the atmosphere (below is a picture of the dump site)  The Public Utility Company, operator of the dumpsite, has no means to manage, control or collect LFG, due to the lack of funds and inadequate technology. The legislation requiring compulsory collection of LFG from dump sites is lacking, both in the legal framework of the Republic of Serbia and in the Municipality of Nis. The only requirement is to vent the LFG in order to avoid the explosion risk.
Applied methodology	AMS – III.G. ***"Landfill methane recovery"*** AMS - I.D. ***"Renewable electricity generation for a grid"***
GHG offset	It is estimated that the project has the capacity to reduce emissions of nearly ***386.000*** tCO_{2eq} for the period 2008 – 2018.
Sustainability	The following non-GHG related environmental benefits have been identified as a result of the project: • Increase of the safety level on the landfill, due to reduced risks of explosion or

	contamination from uncontrolled release of LFG; • Reduced contamination of ground water resources, due to the promotion of capping activities; • Reduction of obnoxious smells inside and outside the dumpsite area. Implementation of a landfill gas utilization project at the site would have the following positive effects on the social indicators: • Technologies for gas utilization will be transferred regionally and nationally; • The project will have a minor, however positive, impact on the employment in the local area, through recruitment of staff engaged on the operation and maintenance of the landfill site.
Current status	Specific technical information have been collected through questionnaires and site visits and the local site owner agrees on the project implementation
Estimated investment cost	Around 1,3 million € (including suction cost, collection cost, modular electricity plant, flaring cost, engineering cost, CDM cost)
Local partners	County, Municipality and local Public Utility Company

Project title *Ref. No. 7*	**AWMS METHANE RECOVERY PROJECT FOR THE FARM „DRAGAN MARKOVIC“ OBRENOVAC**
Project description	The proposed project activity intends to improve current Animal Waste Management System (AWMS) established on the farm “Dragan Markovic” located in the vicinity of Obrenovac settlement. These changes encompass the promotion of the existing open lagoon system for swine manure treatment into a simplest type recovery system, based on the transformation of existed lagoon into covered anaerobic digester. The GHG emission reduction will be achieved by the transformation of CH_4 into CO_2 through combustion of collected digester’s biogas. Potential second project phase might include utilization of biogas from manure digesting. Biogas could be used as a fuel, replacing oil and electricity, which is currently used for barns heating in order to maintain intensive swine growth. The expected result from this project activity will be a significant reduction in the volume of methane (CH_4) and nitrous oxide (N_2O) emission compared to those emissions that would otherwise occur in a scenario with traditional swine manure treatment systems. The farm, which is located 50 km from Belgrade, has an annual production of 30.000 pigs of average weight of 50 kg. The baseline treatment system consists of barns internal sewage system, mixing tank and one open/anaerobic lagoon which are located in the vicinity of the Sava riverbank. In the lagoon, manure is partly digested at the ambient temperature by naturally occurring microorganisms, while the solid phase settles on the bottom of the storage facility. When the lagoon is full, solids collected at the bottom of the lagoon are removed and used as fertilizer. Anaerobic digestion process that takes place inside the lagoon leads to the direct release of CH_4, N_2O and CO_2 into the atmosphere. Besides the existing legislation in the Republic of Serbia that establishes strict water quality parameters that do not allow manure to be discharged into water bodies, there is no legislation that requires a specific swine manure treatment.
Applied methodology	AMS III.D – ***“Methane recovery in agricultural and agro industrial activities”***
GHG offset	It is estimated that the first phase of project activity has a capacity to avoid emissions of ***84.000*** 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: • Protection of the quality of recipient water body; • Ground water protection; • Elimination of unpleasant odour; • Improvement of manure management practice in the area.
Current status	Specific technical information have been collected through questionnaires and site visits and the local site owner agrees on the project implementation

Estimated investment cost	Around 260.000 € (including lagoon cost, gas handling cost, piping cost, flaring cost, engineering cost and CDM cost)[6]
Local partners	Company “Dragan Markovic A.D.”

[6] Estimates have been carried out based on US EPA publication “US Methane Emissions 1990-2020:Inventories, Projections and Opportunities for Reductions, Chapter V-Livestock Manure Management”, September 1999

Project title Ref. No.8	**AWMS METHANE RECOVERY PROJECT – PKB BELGRADE BULL FARM UNIT "NOVA CETVORKA"**
Project description	The objective of this project is to replace the existing open lagoon system for treatment of bull manure in the only one farm unit applying the simplest type recovery system, covered anaerobic digester. GHG emissions reduction from the biggest agricultural company in the vicinity of the capital city is achieved by means of transformation of methane into carbon dioxide through combustion of collected digester's biogas. The farm unit "Nova Cetvorka" has a yearly production of 2.500 bulls with an average weight of approximately 200 kg and daily manure flow of 50 m^3. The Public company "PKB", which is located in the Belgrade surroundings, owns 22.000 ha of agricultural land and another 14 farms, up to 5 km away among each other, where more than 15.000 cows, app. 500 kg average weight, and 2.000 pigs, apprx. 50 kg average weight, are grown on annual basis. Manure from these farms is mixed with straw and collected as a solid phase. The solids, 159.000 t per year (with or without litter) are collected and stored in bulks for a long period of time (several months) before any disposal. The baseline treatment system for farm unit "Nova Cetvorka" consists of barns internal sewage system, mixing tank and one open/anaerobic lagoon which are located in the vicinity of the Dunav riverbank. In the lagoon, manure is partly digested at the ambient temperature by naturally occurring microorganisms, while solid phase settles on the bottom of the storage facility. When the lagoon is full, solids from the bottom are removed and used as fertilizer. Anaerobic digestion process that takes place inside the lagoon leads to the direct release of CH_4, N_2O and CO_2 into the atmosphere. The project boundary for the baseline and project scenario is restricted only to on – site emissions of the farm unit "Nova Cetvorka". Project activity is based on transformation of existing open lagoon into covered anaerobic digester by covering the lagoon with very high durability cover material, implementing a collection system and system for flaring or utilization of generated methane. Besides the existing legislation in the Republic of Serbia that establishes strict water quality parameters that do not allow manure to be discharged into water bodies, there is no legislation that requires a specific bull manure treatment.
Applied methodology	AMS III.D – ***"Methane recovery in agricultural and agro industrial activities"***
GHG offset	It is estimated that the project has a capacity to avoid emissions of around ***52.000*** 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: • Possibility to expand project to other farms inside the company; • Protection of the quality of recipient water; • Ground water protection;

	• Elimination of unpleasant odour; • Improvement of manure management practice in the area.
Current status	Specific technical information have been collected through questionnaires and site visits and the local site owner agrees on the project implementation
Estimated investment cost	Around 260.000 € (including lagoon cost, gas handling cost, piping cost, flaring cost, engineering cost and CDM cost)[7]
Local partners	Public company "PKB" Belgrade

[7] Estimates have been carried out based on US EPA publication "US Methane Emissions 1990-2020:Inventories, Projections and Opportunities for Reductions, Chapter V-Livestock Manure Management", September 1999

Project title *Ref. No.9*	**AWMS METHANE RECOVERY PROJECT – PTK "PANONIJA" FROM BACKA TOPOLA**
Project description	The project consists of an improvement to the common practice in the Republic of Serbia, of an Animal Waste Management System (AWMS), reducing an important volume of GHG. The technology implementation is based on use of the existing lagoon by transformation it to the covered anaerobic digester. Emission reduction will be achieved by transformation of generated methane into carbon dioxide through combustion of digested biogas. The farm, "Panonija", has a yearly production of 40.000 pigs with average weight of more than 50 kg. PTK "Panonija" company is a private joint venture company which majors in swine culture and supplemented by crop growing, processing and selling various agricultural products. "Panonija" farm has a modern hoggery, combined with swine breeding, feed processing, complex fertilizer producing and meat processing. But with out relevant CDM project experience. The baseline treatment system consists of barns internal sewage system and pipeline of less then 500 m that leads manure into the first of three existing anaerobic lagoons. In the first lagoon, manure is partly digested at the ambient temperature by naturally occurring microorganisms, while the solid phase settles on the bottom of that lagoon. Anaerobic digestion process that takes place inside the lagoon leads to the direct release of CH_4, N_2O and CO_2 into the atmosphere. At the present time, no limit has been set for the emission of biogas from hoggery by law or statute in the Republic of Serbia. Because of the economic barrier, the project of making use of hoggery biogas is difficult to be carried on without the support from CDM. In that case, methane will continue to emit into atmosphere from Panonija's hoggery.
Applied methodology	AMS III.D – ***"Methane recovery in agricultural and agro industrial activities"***
GHG offset	It is estimated that the project has a capacity to avoid emission of more than ***112.000*** tCO_{2eq} for the period 2008 - 2018.
Sustainability issues	The following non-GHG related social and environmental benefits have been identified as a result of the project: • Improvement of manure management in the area • Organic fertilizer with complete nutrient elements is produced during the swine waste treatment. This organic fertilizer can accelerate sustainable agriculture by improve the soil particle structure and fertility. • It can be served as a technical and demonstrate model for the national hoggeries in a large or middle scale. • The economic benefit from the CER can partly compensate the company's payout.

Current status	Specific technical information have been collected through questionnaires and site visits and the local site owner agrees on the project implementation
Estimated investment cost	Around 310.000 € (including lagoon cost, gas handling cost, piping cost, flaring cost, engineering cost and CDM cost)[8]
Local partners	Farm owner

[8] Estimates have been carried out based on US EPA publication "US Methane Emissions 1990-2020:Inventories, Projections and Opportunities for Reductions, Chapter V-Livestock Manure Management", September 1999

Project title Ref. No. 10	**AWMS METHANE RECOVERY PROJECT – PP "POBEDA" FROM BACKA TOPOLA**
Project description	The objective of the project is to collect and combust methane from the manure treatment system of the swine hoggery by transforming existing lagoon into covered anaerobic digester. That would lead to emission reduction through transformation of generated methane into carbon dioxide through the process of combustion of digested biogas. This project is representing a improvement of common practice of Animal Waste Management System (AWMS) in the Republic of Serbia. The farm has a yearly production of 30.000 pigs with average weight of more than 50 kg. PP "Pobeda" is a private joint venture company which majors in swine culture for the meat factory in nearby town. Also it is supplemented by crop growing, processing and selling various agricultural products. The farm has a modern hoggery, combined with swine breeding, feed processing, complex fertilizer producing and meat processing. But with out relevant CDM project experience. The baseline treatment system consists of barns internal sewage system and of two existing open lagoons. In the first lagoon, manure is partly digested at the ambient temperature by naturally occurring microorganisms, while the solid phase settles on the bottom of that lagoon. Anaerobic digestion process that takes place inside the lagoon leads to the direct release of CH_4, N_2O and CO_2 into the atmosphere. After the first lagoon the manure overflow to the second lagoon where the process of GHG emission continues. At the present time, no limit has been set for the emission of biogas from hoggery by law or statute in Republic of Serbia. Because of the economic barrier, the project of making use of hoggery biogas is difficult to be carried on without the support from CDM. In that case, methane will continue to emit into atmosphere from Pobeda's hoggery.
Applied methodology	AMS III.D – ***"Methane recovery in agricultural and agro industrial activities"***
GHG offset	It is estimated that the project has a capacity to avoid emission of more than ***84.000*** tCO_{2eq} for the period 2008 - 2018.
Sustainability issues	The following non-GHG related social and environmental benefits have been identified as a result of the project: • Improvement of manure management in the area • Organic fertilizer with complete nutrient elements is produced during the swine waste treatment. This organic fertilizer can accelerate sustainable agriculture by improve the soil particle structure and fertility. • It can be served as a technical and demonstrate model for the national hoggeries in a large or middle scale. • The economic benefit from the CER can partly compensate the company's payout.
Current status	Specific technical information have been collected through questionnaires and site visits and the local site owner agrees on the project implementation

Estimated investment cost	Around 260.000 € (including lagoon cost, gas handling cost, piping cost, flaring cost, engineering cost and CDM cost)[9]
Local partners	Farm owner

[9] Estimates have been carried out based on US EPA publication "US Methane Emissions 1990-2020:Inventories, Projections and Opportunities for Reductions, Chapter V-Livestock Manure Management", September 1999

Project title Ref. No. 11	**AWMS METHANE RECOVERY PROJECT FOR THE FARM "STARI TAMIŠ", PANČEVO**
Project description	The objective of this project is to replace the existing anaerobic lagoon system for swine manure treatment with the simplest recovery system, based on the implementation of covered anaerobic digesters instead of existing open lagoon. The emission reduction is achieved by transformation of CH_4 to CO_2 through combustion of digester's biogas. The farm has a production of 25.000 pigs per year, with an average weight of 60 kg. The baseline treatment system consists of barns` internal sewage system, storage pit and 4 lagoons. The digestion process in the existing anaerobic lagoons leads to direct release of CH_4, N_2O and CO_2 into the atmosphere. Upon leaving the lagoon, the treated waste water is being discharged into the "Nadela" canal which has already been identified as an environmental hot spot of the region. Moreover, in order to manage animal carcasses an electric furnace has been bought but due to high energy consumption it has never been operating. Potential second project phase might include utilization of biogas from manure digesting in the furnace and/or for barns heating in order to maintain intensive swine growth.
Applied methodology	AMS III.D – ***"Methane recovery in agricultural and agro industrial activities"***
GHG offset	Emission reductions, as an outcome of the project activity, are dependant on the characteristic of installed equipment for utilisation of digested biogas. However, rough estimations show that the project has a capacity to reduce emissions only by flaring of about ***115.000*** 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: • Protection of quality of the recipient water body; • Ground water protection; • Elimination of unpleasant odour; • Improvement of manure management in the area; • Decrease of oil and electricity consumption from the grid.
Current status	Specific technical information have been collected through questionnaires and site visits and the local site owner agrees on the project implementation
Estimated investment cost	Around 280.000 € (including lagoon cost, gas handling cost, piping cost, flaring cost, engineering cost and CDM cost)[10]
Local partners	Farm owner

[10] Estimates have been carried out based on US EPA publication "US Methane Emissions 1990-2020:Inventories, Projections and Opportunities for Reductions, Chapter V-Livestock Manure Management", September 1999

Project title *Ref. No. 12*	**METHANE CAPTURE AT DISTILLERY "ALPIS", KOVIN**
Project description	The Distillery "Alpis" is a privately-owned enterprise in the vicinity of Kovin at the south of the Autonomous Province of Vojvodina. The end product of the distillery is 96% alcohol with production capacity of 10 million litres of alcohol per year. The raw material for alcohol production is sugarcane molasses. The molasses-based distillery generates 15-20 l of wastewater per hour, characterized by high BOD (up to 25.000 mg/l), high COD (up to 75.000 mg/l) and dark colour. The wastewater contains approximately 90% of water and 10% of dry matter. The content of organic in dry matter is up to 70% while remaining 30% is mineral matter. The temperature of the effluent entering lagoon is 60-90 ^{o}C. The existing wastewater treatment system consists of 4 stabilization lagoons, situated 2 km away from the plant and 3,5 km away from the settlement. The treatment process is based on the anaerobic degradation of organic matter and leads to the direct release of CH_4 and CO_2 into the atmosphere. The lagoons have been designed for treatment of 20 l/h of effluent, 24 h/day, 300 days per year (180x100x1m). The detention time of effluent is up to 150 days. The project activity involves the installation of an anaerobic digester with biogas extraction capacity at an existing organic wastewater treatment plant to treat the degradable organic content in the wastewater. After the primary treatment, the wastewater with reduced organic load will enter the existing open lagoon system, while the extracted biogas will be flared. Potential second project phase might include biogas utilization for production of heat energy needed for production process thus replacing fossil fuel which is currently in use. This project represents a possible improvement of common practice with organically heavily loaded wastewaters in the Republic of Serbia.
Applied methodology	The baseline emissions estimation is based on the IPCC Guidelines for National Greenhouse Inventories: Reference Manual (Volume 3). AMS III.H. – ***"Methane Recovery in Wastewater Treatment"***
GHG offset	The baseline emissions estimation is based on the IPCC Guidelines for National Greenhouse Inventories: Reference Manual (Volume 3). Referring to the Manual, the reductions are determined using chemical oxygen demand (COD=74.000 mgO_2/dm^3) of the effluent that enters the lagoon in the absence of the project activity, and the conservative values for the maximum methane producing capacity (Bo=0,21 kg CH_4/kg COD) as well as for methane conversion factor (MCF=0,574). Emission reductions, as an outcome of the project activity, are dependant on the characteristic of installed equipment and digested biogas treatment. However, rough estimations show that the project has a capacity to reduce emissions of more than ***160.000*** tCO_{2eq} for the period 2008-2018.
Sustainability issues	The following non-GHG related social and environmental benefits have been identified as a result of the project: • Implementation of a highly efficient treatment method helps overcoming of technological barriers

	• Introduction of a new complex technology, requires technically skilled manpower for operation and maintenance • Equipment requires minor land surface compared to lagoons • The economic benefit from the CER can partly compensate investments
Current status	Specific technical information have been collected through questionnaires and site visits and the local site owner agrees on the project implementation
Estimated investment cost	Around 250.000 €
Local partners	Plant owner

Project title *Ref. No. 13*	**SHPP VRGUDINAC, SHPP CRVENI BREG, SHPP MALA BELA PALANKA** **(Bundling project)**
Project description	The main objective of the proposed project activity is to generate green electricity using hydroelectric resources, and to sell the generated output to the Serbian grid on the basis of power purchase agreement (PPA). Therefore, by the project implementation, the GHG emissions reduction will be generated, too. This will result in avoiding electricity generation at fossil fuel-fired power plants, i.e. TPPs using mainly lignite. The development of the small scale plants on the renewable energy sources is not a common practice in Serbia, yet. The current electricity price is relatively low, but the Ministry of Mining and Energy is working on the establishing the incentive mechanism for the electricity generated from the renewable energies. It is foreseen the "*feed-in tariff*" system. The clear framework and the prices for the electricity from the renewable energy sources will be established by the middle of this year. In order to decrease, in general relatively high transaction costs, for the development of the project as a CDM one, the three run-off river small hydro power plants Vrgudinac, Crveni breg and Mala Bela Palanka, on the same river flow Nisava, are bundled and considered as one project activity. All three sites are located in the Municipality of Bela Palanka, in the South-Eastern part of Serbia. The municipality covers 308 km^2 and has 33.000 inhabitants. According to the pre-feasibility study /6/ done by the Serbian engineering company, the basic assessed results will be presented in the following text. On the basis of the data from the local hydro-methodological stations on the river Nisava, the average discharge of 24,4 m^3/s was taken for the preliminary estimation of the power potential. The catchment's area of the river Nisava is approx. 3.220 km^2. **SHPP Vrgudinac** has the capacity of 1.350 kW and could generate app. 5.403 MWh of green electricity. It has been foreseen the construction of a 5 m diversion weir, the installation of two turbine units of 675 kW, two synchronous generators and one common transformer. It is necessary to reconstruct the existing village road, around 1 km long. The plant will be connected to the 35 kV power line/6/. **SHPP Crveni Breg,** as the second one in the cascade line, has the capacity of 2.588 kW and could generate app. 11.300 MWh of green electricity. The project activity will supply the electricity generated to the state electricity grid via sub-station and overhead transmission line, through a 4.000 kVA transformer and two power lines of 35 kV (inlet-outlet). Two turbine generating units of 1.386 kW, two synchronous generators and one common transformer are foreseen. Access to the road is provided. The plant will be completely automatic. **SHPP Mala Bela Palanka** has the highest capacity of 4.057 kW and will generate app. 17.770 MWh. Two turbine generating units of 2.086 kW, two synchronous generators and one common transformer are foreseen. It will be necessary to reconstruct about 2 km of the existing local road and about 500 m of the road leading to the powerhouse. The unit is completely automatic. The plant will be connected to the network through a 6.300 kVA transformer and two power lines of 35 kV (inlet-outlet).
Applied methodology	Since the total installed capacity of the SHPPs on the river Nisava is less than 15 MW, the approved simplified methodology ***"Renewable electricity generation for a grid"***- ASM I.D should be applied for this small scale bundled CDM project.

GHG offset	Emission reductions for the entire project are expected to be ***300.000*** tCO_{2eq} for the period 2008-2018, achieved by displacing coal generation from the national grid. However, in order to increase precision and to establish the baseline conservatively, the emission rate for the electricity grid should be recalculated through the project development.
Sustainability	The implementation of this project activity will lead to: • Generation and supply to the national grid approx. 34,5 GWh of electricity per year, on an average, in a renewable, sustainable and environmentally friendly manner; • Improvement the power availability and quality in the local area. The positive aspect of the project implementation is the local companies' involvement and creation of job opportunities, as well as an uniform electricity consumption for the area of the Municipality; • Improvement the road condition, in the length of approx.1,5 km, connecting the project sites and nearby villages to the existing roads; • Assistance the Republic of Serbia in stimulating and accelerating the commercialization of renewable energy technologies and markets, at the grid level and under private ownership, as well as its operation, in order to reduce GHG emissions, while responding at the same time to the increasing energy demand and energy diversification imperatives necessary for sustainable economic growth. Broadened private experience in the development, operation and maintenance of hydropower electricity generation is a significant option for expanding and diversifying Serbian energy resources.
Current status	Pre-feasibility study has been elaborated for all three SHPPs
Estimated investment costs	The estimated investment costs for all three projects are approx. 12 million EUR, which need to be considered again by the development of the feasibility study, involving more detailed assessment.
Local partners	Municipality of Bela Palanka, private local company, EPS

Project title: Ref. No. 14	**BUNDLED PROJECT ON DTD HYDRO SYSTEM**
Project description	The significant surface water resource in the AP Vojvodina is the Danube – Tisa – Danube hydro system (DTDHS). This system extends over a surface area of 20.000 km^2 and comprises canals network whose overall length is about 700 km. The system is used for irrigation, drainage and navigation purposes. According to the "Cadastre of Small Hydro Power Plants in Vojvodina", the construction of SHPP at DTDHS near Novi Sad, Becej and Vrbas with installed capacities of 3MW, 0,85MW and 0,62MW respectively, should be a priority and undertaken simultaneously since their working regime is interconnected. The project activity would supply about 26 GWh/year. Part of the electricity would be used for pumping water back into canal, while the rest would be dispatched to the end-users connected to the national power grid. The proposed SHPPs would be placed next to existing gate structures (water steps). All locations are provided with electricity supply, permanent crew and access road. Conditions for construction are very similar at each location, thus enabling utilization of a typical solution. By bundling the three SHPPs laying on the DTD Hydro System into one CDM project activity, the project participants could develop a CDM project with a significant potential of CERs. The fact that the same company would build, operate and own the facilities represents a rationale for bundling. Furthermore, the transaction cost of PDD preparation in case of bundling will be reduced compared to the costs in case of separately prepared PDDs. According to the Cadastre there are technical possibilities for construction of another 9 SHPPs, with installed power ranging from 0,25 up to 15 MW. The largest potential is near Novi Becej, with estimated installed capacity of 14,8 MW and annual generation of about 50,7GWh. Second largest is SHPP near Kajtasovo, with 1,2 MW of installed capacity and annual production of 8,2 GWh. Considering installed capacity, SHPP Novi Becej must be regarded as a separate project activity, while SHPP Kajtasovo might be added to the above mentioned bundle. The project activity will generate GHG emission reductions by avoiding electricity generation and CO_2 emissions from the coal fuel-fired power plant.
Applied methodology	Taking into the consideration that total installed capacity of bundled SHPPs does not exceed 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	For the period 2008-2018 it is estimated that the project has the capacity to reduce emissions of nearly ***226.000*** tCO_{2eq} without SHPP Kajtasovo or ***296.000*** tCO_{2eq} including Kajtasovo.
Sustainability	The project activity will generate and supply the national grid with electricity, in a renewable, sustainable and environmentally friendly manner. Besides the positive effect with respect to emission reduction, SHPPs may work as pumps, thus providing water supply during critical periods with low level of water in DTD or droughts. Additionally, increased water flow through the canal network would result in protection and improvement of water quality.
Current status	Specific technical information have been collected through questionnaires and site visits

	and the local site owner agrees on the project implementation
Estimated investment cost	In the range of 500.000 -2.500.000 €
Local partners	Secretariat for Energy and Mineral Resources of the AP Vojvodina

Project title Ref. No. 15	**BIOMASS FOR ENERGY PROJECT**
Project description	The project consists in the construction of a new unit, with around 2,5 MW of the installed capacity and annual electricity generation of app. 18 GWh exported to the grid, using biomass residues as fuel. The Municipality has a rather developed wood processing industry. As wood processing complexes become more integrated and environmental legislation more stringent, there is a need for better management of the wood residues. For environmental and economic reasons, traditionally dumped or simply incinerated in the open air wood residues are now being increasingly seen as an alternative fuel. This project is a solution for the biomass residues problem in the region, and it will significantly improve the quality of electricity service in the Municipality. The amount of biomass produced is 10.000 tons of biomass residue per year: • 4.300 tons of sawdust and 5.300 tons of wood chips. This area is forested mostly by Fagus silvatica.
Applied methodology	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 a capacity to avoid emissions of nearly ***160.000*** tCO_{2eq} for the period 2008-2018. Emissions due to transport of the biomass to the generation facility were not included.
Sustainability	The project is helping the Host Country fulfil its goals of promoting sustainable development. Specifically, the project: • Increases employment opportunities in the area where the project is located; • Diversifies the sources of electricity generation; • Uses clean and efficient technologies, and preserves natural resources, thus the project will meet the requirements of the Agenda 21. • Acts as a clean technology demonstration project, encouraging development of modern and more efficient generation of electricity and thermal energy using biomass fuel throughout the country; • Optimizes the use of natural resources, and avoids new uncontrolled waste disposal places, using a large amount of wood residues from the region
Current status	Specific technical information have been collected through questionnaires and site visits. Representatives of the Municipality of Ivanjica have expressed a keen interest in this project, as well as a number of the local public and private wood processing companies.
Estimated investment cost	Estimated cost of construction of unit with around 2,5 MW of the installed capacity for electricity generation for the grid, using wood biomass residues as fuel is 5,64 mill. EUR.
Local partners	Municipality of Ivanjica, local wood processing companies

Project title: Ref. No. 16	**AWMS METHANE UTILIZATION PROJECT – PIK "BEČEJ"**
Project description	The purpose of the project is to capture and process biogas from three farms, owned by one of the biggest pig, diary cattle, food and agricultural crops producer in Serbia. This company owns several farms with the average annual manure generation up to 500.000 m^3 liquid and 35.000 t solid, as well as a huge amount of biomass residues from agricultural land with the area of 14.500 ha. The expected result from this project activity will be a significant reduction in the volume of methane (CH_4) emissions compared to those emissions that would otherwise occur in the scenario with traditional manure treatment system consisting of anaerobic lagoons. Due to the anaerobic processes that take place inside the anaerobic lagoons, direct release of CH_4, N_2O and CO_2 into the atmosphere occurs. In order to avoid emissions of the mentioned GHG gases, it is planned to apply the anaerobic digester technology on site. This scenario would be applied on the farms "Zalivno polje", "Kis-Imre" and "Novo Selo" specialized in the production of dairy cattle (1.500 per year) and pigs (around 100.000). The farm "Novo Selo", the largest of those farms, has a daily inventory of app. 69.000 pigs. The manure generated on this farm, represent a significant source of biogas, which may be used within a CHP to cover energy demands of the farm. On the basis of available manure amounts, installed capacity of the CHP may be estimated at $1MW_{el}$, producing 8000 GWh of electricity per year. According to existing development plans, the most preferable location for introduction of digester is the farm "Zalivno polje" with a daily inventory of app. 25.000 pigs. Generated amount of manure would be mixed in the digester with biomass residues from Vegetable Processing Industry „Flora" and from adjacent agricultural land. Total amount of biomass to be fermented is estimated at 20.000 t/year, which is sufficient for production of around 2000 m^3/day of biogas. If used in CHP unit, this amount of biogas would be able to cover total energy demand of the farm. The total amount of agricultural residue from 14.500 ha also represents significant potential for GHG emission reduction. One of the possibilities for utilization of the agricultural residues is through fuel switch for barn heating or seed drying purposes but the project idea is still to be developed.
Applied methodology	AMS III.D – ***"Methane recovery in agricultural and agro industrial activities"*** AMS I.C. – ***"Thermal energy for the user"*** AMS I.D. – ***"Grid connected renewable electricity generation"***
GHG offset	It is estimated that the project has a capacity to avoid emissions ***600.000*** tCO_{2eq} for the period 2008-2018 only from flaring of generated biogas, while the construction of CHP at the farm "Novo Selo" would provide additional reduction of 70.000 tCO_{2eq} for the same period.
Sustainability	The following non-GHG related social and environmental benefits have been identified as a result of the project: • Decrease of the consumption of fossil fuel and electricity from the grid; • Protection of the recipient water quality; • Ground water protection;

	• Elimination of unpleasant odour; • Improvement of manure management practice in the area.
Current status	Specific technical information have been collected through questionnaires and site visits and the local site owner agrees on the project implementation
Estimated investment cost	Approximately 3,7 M€ including CHP unit, transaction costs and operation and maintenance. Estimated investment costs for digester with appurtenances is around 500.000€[11]
Local partners	Company “PIK Becej” – currently in the privatization process Municipality of Becej

[11] Estimates have been carried out based on US EPA publication “US Methane Emissions 1990-2020:Inventories, Projections and Opportunities for Reductions, Chapter V-Livestock Manure Management”, September 1999

Project title Ref. No. 17	**WIND ENERGY USE IN CENTRAL SERBIA**
Project description	This project may be one of the pilot projects in the wind energy use for electricity production in the region. There is a wide range of wind potential in Serbia. All investigations and research in this field are related to certain numerical simulations on the basis of data obtained from meteorological stations. Several measurements are already in progress or conducted for a few locations, mainly in the Province of Vojvodina, within the scope of work of some foreign and local companies and institutions. The purpose of the proposed project is to contribute to the commercialization of wind energy in the region of Central Serbia, through the operation of one of the first wind energy plants in Serbia using small and large scale wind turbines. The project concept should be focused on the installation of towers with measurement equipment, on pre-selected locations in the south-eastern part of Serbia. The above locations have the highest wind potential, according to the existing data base and developed model. In this region, the range of wind speeds vary from 5,5-6,2 m/s, at the height of 10 m. According to certain rough estimations, the wind generators, using wind potential at the project location, could have the installed capacity of 20 MW with an approx. 52 GWh annual electricity generation.
Applied methodology	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 a capacity to avoid emissions of nearly ***460.000*** tCO_{2eq} for the period 2008-2018.
Sustainability	In addition, the project aims at contributing to an overall sustainable development of the region, from the economic, environmental and social point of view.
Current status	Specific technical information have been collected through questionnaires and site visits. Representatives of EPS expressed readiness for entering into a joint venture with foreign companies.
Estimated investment cost	Approx. 20 million €
Local partners	EPS

Project title Ref. No.18	**HIP-AZOTARA IN PANCEVO: INTERVENTIONS FOR ENERGY EFFICIENCY IMPROVEMENTS**
Project description	The project consists in the implementation of actions for energy efficiency improvement in HIP-Azotara, the leading producer of mineral fertilizers and nitric compounds of the Balkan region. The main products of the company are Nitric Acid, Urea, Ammonium Nitrate (AN) and Calcium Ammonium Nitrate (CAN), while the energy carriers consumed by the plant are essentially electric power and natural gas. The proposed project is composed of interventions in different process units, with the final aim is to recover wasted heat from different production phases. The project will include the following actions: • Optimization of absorption column operations at the Nitric Acid Production Plant: this action will include the installation of a water-glycol closed circuit to recover refrigeration units from heating low temperature liquid ammonia thus replacing the 3.5 barg steam previously used; the recovered refrigeration units are used to cool absorption column make-up water and absorption column internal coils through the water-glycol closed circuit; • Wasted steam recovery and condensation at all AN Production Plants: this action will include the recovery of the whole steam currently vented to the atmosphere and the utilization of its thermal energy to improve the thermal efficiency of the above Plants and to purify the relevant Steam Condensate in order to make it suitable to be fed to all Nitric Acid Plants (N°1,2 and 3) as make-up process water. This will provide for both the reduction of water consumption and the reduction of waste. • Heat recovery at the Nitric Acid Production Unit No. 3 compressor stage: this action will include the installation of two specific heat exchangers between the two air compressors stages (first and second). The temperature of air entering the second stage is controlled by producing steam and by warming the water closed circuit used to vaporize ammonia; • Wasted heat recovery from the tail gases of the Nitric Acid Unit: this action will include the installation of two additional heat exchangers to lower the temperature of gases vented to the stack and super-heat steam and to pre-heat boiler feed water;
Applied methodology	To be developed
GHG offset	Approx ***300.000*** tons CO_{2eq} for the period 2008-2018.
Sustainability	The intervention will have a significant positive impact in the reduction of the air emissions (CO_2, NO_x, etc.)
Current status	Specific technical information have been collected through questionnaires and site visits and the local site owner agrees on the project implementation Feasibility Study expected to be issued on June 07 (business plan included)
Estimated investment cost	Estimated capital investment is app. 8.500.000 €
Local partners	HIP AZOTARA

Project title Ref. No. 19	**JKP GREJANJE DISTRICT HEATING IN PANCEVO: COMBINED HEAT AND POWER (CHP) PLANT**
Project description	JKP Grejanje District Heating (DH) is providing heat to the urban area of Pancevo. The DH system is supplied by two main centralized energy generation units (Heat Plant Kotez , 53 MWt; Heat Plant Sodara 25 MWt) plus several small and domestic boilers. The equipment and the whole system of steam generation and energy distribution are outdated and need rehabilitation. The DH shows a great potential for energy efficiency improvement and JKP Grejanje is planning interventions aimed at reorganizing the whole district heating system. The main interventions are: installation of a new heat plant (Heat Plant Centar, 75 MWt) and dismantling of small distributed heat generation plants with low efficiency; revamping and expansion of the heat distribution net; improvement of automation/control and heat contabilisation. The Company is also interested in developing a combined production of electrical and thermal power at the existing Kotez Heat Plant. This intervention mainly consists in the modification of the existing Kotez Heat Plant in a Combined Heat and Power (CHP) plant, with electrical power of cc 24 MWe and a thermal power production of cc 25 MWt, covering approximately 70% of the total yearly heat demand of the area. The envisaged solution provides for the installation of three gas motors with auxiliaries, while the existing KOTEZ boilers will be used as integration/ reserve heat sources.
Applied methodology	AM 0014 - *"**Natural gas-based package cogeneration**"*
GHG offset	Approx. ***600.000*** tons CO_{2eq} for the period 2008-2018.
Current status	Specific technical information have been collected through questionnaires and site visits and the local site owner agrees on the project implementation Feasibility Study for CHP plant is expected to be issued on June 07 (business plan included).
Estimated investment cost	Estimated capital investment is app. 17.500.000 for CHP
Local partners	JKP - GREJANJE

Project title *Ref. No. 20*	**ENERGY EFFICIENCY IN STREET LIGHTING – CENTRAL SERBIAN REGION**
Project description	This project activity is related to the improvement of the existing street lighting system by introduction of more efficient lighting technologies in four neighbouring municipalities in the Central Serbia region, with approx. 270.000 inhabitants. At present, mercury bulbs, consuming more electricity for the same magnitude of light, are widely used, while their lifetime period is three times shorter with respect to the sodium bulbs. The project activity would consist of replacing nearly 16.000 mercury bulbs by the sodium bulbs. In such a way, the energy efficiency would be increased by 46 % in average, while the electricity consumption would be decreased by more than 6.500 MWh per year. Likewise, replacement of obsolete mercury bulbs by the high pressure sodium bulbs, with a longer lifetime period, would significantly reduce the overall maintenance costs. The above mentioned measures would lead to GHG emissions reduction from the grid. In general, energy efficient lighting projects do not contribute significantly to the reduction of carbon emissions. However, when applied as a part of a larger project, they may have a notable contribution to the reduction of CO_2 emissions. Maintenance measures and proper care (during monitoring periods) should be undertaken, to ensure the on-going use of the new lighting system. The above mentioned project may be used as a model in order to define and predict the possibilities for developing larger projects, for example lighting efficiency improvement in buildings or in the streets, in larger cities in Serbia.
Applied methodology	The calculated emissions reductions are under the maximum limits of the small scale methodology ***"Demand-side energy efficiency programs for specific technologies"*** (II.C), which could be applied in the case of this project.
GHG offset	It is estimated that the project has a capacity to avoid emissions of over ***60.000*** tCO_{2eq} for the period 2008-2018.
Sustainability issues	The project will improve the power availability and quality of light in the local area. In addition the project aims to contribute to an economically and environmentally sustainable development of the region.
Current status	There is no high emission reductions value, but based on sustainability criteria this could be the project with medium potential under the small scale group. The pre-feasibility study for some of the cities has been elaborated, and for the others the preliminary data were collected. Representatives of the municipalities have shown a keen interest to start cooperation on the implementation of this kind of projects.
Estimated investment cost	Investments: - for material: 1.465.000 € - for replacement works: 263.000 € SUM of investments: 1.728.000 € Annual savings: - savings due to the reduction of electricity consumption: 258.300 €/year

	- savings due to longer lifetime period of bulbs (works and material): 115.800 €/year SUM of annual savings: 374.100 € Therefore, estimated payback period is 4 – 5 years.
Local partners	Municipalities of Cacak, Ivanjica, Uzice, and Pozega

Project title: Ref. No. 21	**ENERGY EFFICIENCY IN STREET LIGHTING – CITY OF NIS**
Project description:	The project activity consists of improving existing street lighting system in one of the biggest municipality in Serbia with more than 250.000 inhabitants, via more efficient lighting technologies. At the present, usage of mercury bulbs in the street lighting system is about 70%. They consume more electricity for the same magnitude of light and their lifetime period is one year and that is three times shorter than bulbs made with sodium. Also, there is wide usage of inefficient switching equipment based mostly on time switchers and less on photoelectric switching cells. Present status lead to excess electricity consumption for that level of lighting. Also, notable stage of pollution is present from mercury bulbs that are no longer in use due to fairly short lifetime period. Therefore, the project activity would consist in replacing of 9.287 obsolesced mercury bulbs with high pressure sodium ones. That would result in electricity savings of more than 2.000 MWh per year what is about 44% of present consumption. Also, reduced electricity demand for street lighting would lead to decrease of distribution losses. Possible implementation of management system would give possibility to exceed reduction level that is in the proposed project activity. The management system could consists in equipment that would enable switching of whole system from one point and partial work of bulbs what would reduce light intensity in periods of low traffic level. All that energy saving measures would cause GHG emission reductions from the grid. Replacing mercury bulbs with sodium ones would lead in cutback of maintenance costs and avoidance of dumping about 6.500 mercury bulbs on city dumpsite per year. This project also could be a base to define and predict the possibilities for the development of the relevant larger project, for example lighting efficiency improvement in street light in the whole country.
Applied methodology	The calculated emissions reductions are under the maximum limits of the small scale methodology ***"Demand-side energy efficiency programs for specific technologies"*** (II.C), which could be applied in the case of this project.
GHG offset	This project activity is considered as bundling of seven municipalities. It is estimated that the project has a capacity to avoid emission of more than ***18.000*** tCO_{2e} for the period 2008-2018.
Sustainability issues	The project will improve the power availability and quality of light in the local area. In addition the project aims to contribute to an economically and environmentally sustainable development of the region.
Current status	The preliminary data have been collected. The representatives have shown open will to start cooperation regarding to the implementation of the project.
Estimated investment cost	Investments: - for material: 855.000 € - for replacement works: 150.000 € SUM of investments: 1.005.000 €

	Annual savings: - savings due to the reduction of electricity consumption: 83.000 €/year - savings due to longer lifetime period of bulbs (works and material): 68.400 €/year SUM of annual savings: 151.400 € Therefore, estimated payback period is 6 – 7 years.
Local partners	City of Nis

Project title *Ref. No. 22*	**COGENERATION PLANTS IN INDUSTRIAL ZONE IN CACAK**
Project description:	Industrial zone, located in Cacak Municipality, is one of the biggest energy consumers in the region. In the last years the natural-gas distributive network has been introduced in to this zone. Since, the price of the natural gas is higher comparing to the heavy fuel oil, most of the factories in this zone, due to the lack of finance, use crude oil instead. The heat produced in this industrial complex is used for two purposes, for industrial processes and for the district heating of the neighboring parts of the town. One old coal powered CHP plant with installed capacity of 8 MWel, already exists in this zone and has not been operational for ten years. Almost all of these factories are in the process of privatization. The project idea foresees the installation of the cogeneration plant with installed capacity 3 MW_e, calculated to cover the electricity demand for three factories, as the biggest electricity consumers. The natural gas-based turbine cogeneration system would generate about 18 GWh of electricity, eliminating the electricity purchases from the grid for the three factories. There is possibility, from the technical point of view, to install also the CHP unit with much higher capacity in order to export extra electricity to the national grid. The GHG emission reductions were calculated on the basis of: • Higher fuel use efficiency by introduction of the cogeneration plant where the fuel with less carbon content (natural gas) is burnt to generate the same amount of steam and electricity. • Electricity co-generated by burning natural gas offsets electricity supplied from the grid and reduces transmission and distribution losses which in Serbia are almost the biggest in the Europe. Since, the current Annual steam production in this factories is around 18,45 t/h of steam and in the winter period up to 23 t/h, it is obvious that there is a quite large energy demand. Also, annual electricity Demand is around 12.800 MWh. In order to ensure the mentioned deMands in sustainable manner it is necessary to initiate the measUres, leading to energy efficiency improvement and energy savings.
Applied methodology	The project activity is small-scale energy efficiency project with the total saving less than 60 GWhel (equivalent to maximal saving of 180 GWhth) in the fuel input to the generation unit. The estimation of the emission reduction could be calculated by using the simplified methodology for small scale projects ***"Supply side energy efficiency improvements – generation"*** II.B.
GHG offset	In the case of the implementation of the CHP unit with 3 MWel, the project activity has a capacity to avoid GHG emissions in the value of app. ***100.000*** tCO_{2eq} for the period 2008 - 2018.
Sustainability issues	The project will contribute to sustainable development of the local area by mitigating negative effects related to high energy consumption and GHG emissions, through implementation of the cogeneration plant in the industrial zone.
Current status	Specific technical information have been collected through questionnaires and site visits and the local site owner agrees on the project implementation

Estimated investment cost	Approximately 4.000.000 €
Local partners	Factory Sladara, Factory FRA, Factory “ Bozo Tomic”, and Municipality of Cacak

Project title *Ref. No. 23*	**AFFORESTATION AND WOOD BIOMASS UTILIZATION IN THE SPECIAL RESERVE OF NATURE**
Project description	The project concept conceives three possible project activities. The first project activity is afforestation of sandy terrain in protected area of the Special Reserve of Nature, currently covered with haw. The Special Reserve of Nature "Deliblatska pescara" is the only sandy terrain in Europe, located in the north-eastern region of Serbia called Banat, 50 km east of Belgrade and 40 km from Romanian border. Total area foreseen to be afforested by this project is 737,84 ha. It is divided in four complexes consisting of 193,48 ha, 124,05h a, 265,26 ha and 155,05 ha and covered with haw. Shrub vegetation emerged after grazing ceased, and haw emerged on the best quality soil of the sandy terrain. These complexes are comprised of several connected plots bigger than 10ha. Mosaic nature of the terrain and intensive micro-climatic diversity demand mosaic planting of seedlings and in that respect final disposition of species have to be defined by a detailed project proposal. Removal of haw would be partial and gradual (in stripes), in order to ensure protection for young seedlings. Later on, haw would be successively removed in total. After partial removal of haw, area would be afforested with 2.500 seedlings per ha, and time period for afforestation is estimated to be 3-4 years. Nursing activities include hilling during the first three years, haw removal and after 25 years, thinning activities. Protection from pests and diseases would be performed during first several years and protection against fires would be established around afforested complexes. Estimated rotation period is 90 to 120 years. The second possible project activity concerns utilization of removed haw and forestry waste generated through regular activities of forest management, on the territory of the Special Reserve of Nature. Through annual harvesting of 36.000 m^3 of black locust and 10.000 m^3 of pines, 3.200 t of forestry waste is being generated annually. The average transport distance between the source of forestry waste and the storage facility is app. 10 km. The biomass mentioned could be used for heating purposes in the educational center "School in Nature", located in the area of the Special Reserve of Nature. The educational center is currently consuming 225 t of residual fuel oil annually, for the heating purposes. In order to substitute oil consumption in this facility, installation of thermal boiler with 1 MW_{th} of installed capacity and annual consumption of 700 t of forest wood chips, stored and air-dried for several months, would be sufficient. The educational center "School in Nature" has a capacity of 600 beds in the pavilions, 50 beds in the bungalows, one large dining room and a kitchen for the whole complex. Today, the school is a place where seminars, workshops, training courses, and sports trainings are organized. The third possible project activity is electricity production using wood as a fuel. Taking into account that the annual harvesting volume on the territory of the special reserve of nature is 46.000 m^3, available wood biomass would be enough to feed, with forest wood-chips (30% moist.), power generator that has 2MW of installed capacity and to produce 14 GWh of electricity to the grid. Current price of 1 m^3 of black locust in Serbia is 25 EUR. No location for constructing mentioned power plant has been identified up to date.
Applied methodology	Carbon Sequestration Evaluation Model; AMS III.B. – ***"Switching fossil fuels"***; AMS I.D. – ***"Grid connected renewable electricity generation"***.

GHG offset	Reduction of GHG emissions from afforestation activity would be cumulatively around ***39.000*** tCO_{2eq} for the period 2008-2018. Reduction of GHG emissions from the fuel switch activity would be cumulatively around ***7.000*** tCO_{2eq} for the period 2008-2018. Reduction of GHG emissions from electricity generation would be cumulatively ***121.000*** tCO_{2eq} for the period 2008-2018.
Sustainability	• Increase in carbon sequestration intensity and forestation rate would be achieved; • In the protected area of the special reserve of nature, clean technology for the heating of the educational center will be introduced; • Issue of wood waste generated through regular forest maintaining activities would be solved in an environmentally friendly manner; • Basic ground for the long-term sustainability of the nature protected area would be established; • Promotion of renewable energy sources and diversification of energy sources, in general, would be supported through the actions proposed.
Current status	Specific technical information have been collected through questionnaires and site visits and the local site owner agrees on the project implementation
Estimated investment cost	Estimated cost of afforestation is 1,25 mill EUR. Estimated cost of the fuel switching is 310.000 EUR. Estimated cost of installing 2 MW for electricity generation from wood biomass is 4,5 mill EUR.
Local partners	Public Company for Forest Management “Vojvodinasume”

Project title *Ref. No. 24*	**ESTABLISHMENT OF THE FOREST WIND BELTS FOR AGRICULTURE LAND**
Project description	The total area of Vojvodina is 2.151.300 ha, whereby 75% of the territory is agriculture land of the finest sort, and the vast majority of local households depend on agriculture and food industry. In that respect, arable land being under constant pressure of wind erosion, endanger sustainable development of the local community. Geologic pad on the territory of the Municipality of Kikinda is mainly loess, 5-6m thick. There are several types of soil present on the territory of this municipality, mainly different sorts of mould, but there is also some percent of saline land. Forest cover of the municipality is around 1%, and the rest of the territory is mainly under shrubs, or it is used for agriculture production. The total afforestation area included in the project is 1.831,4 ha, i.e. 1.814,9 km long wind-belts network along the traffic arteries, river flows and canals, and infield land roads. This represents 2,34 % of the total municipality area. In respect to the climatic conditions, the most suitable wind-belts for the municipality would be the belts which are maintained in a thinned state. The belt would be comprised of 3 to 6 rows, and its width would range from 7,5 to 12 m, depending on micro-conditions. In more arid parts, the space between the rows should be 2,3 to 3 m. Taking into account that the main courses of wind are north-west and south-east, the main protective forest belts would spread from north-east to south-west. In refer to the expansion of saline land, the project on establishment of protective forest wind-belts also include a part on the activities focused on prevention and remediation of this type of land, which would also support development of beekeeping and hunting, and in that respect economic development of the local community. In addition to 1.831,4 ha foreseen for afforestation by the project, 550,77ha of saline land could also be included in the project.
Applied methodology	Carbon Sequestration Evaluation Model
GHG offset	Reduction of GHG emissions from establishing protective forest wind belts in the Municipality of Kikinda would be around ***36.000*** tCO_{2eq} for the period 2008-2018, cumulatively.
Sustainability	• Majority of local households depend on agriculture and food industry. In that respect, arable land being under constant pressure of wind erosion endangers sustainable development of the local communities; • Current forest cover of the Municipality is around 1%. Establishment of wind belts would increase the rate of the forest cover and contribute to the achievement of respective national goals; • The project would also contribute to the economic development of the local community, taking into account that project activities also refer to prevention and remediation of the saline land, and support development of beekeeping and hunting.
Current status	Project concept. The described project activity has been defined according to the data from the existing

	official documents: strategies, technology needs assessments etc.
Estimated investment cost	Cost of establishment of protective forest wind belts in the Municipality of Kikinda has been estimated at 2,38 mill EUR. The price of wood that would derive from the maintaining activities of the forest wind belts is 30 EUR/m^3, while they enter exploitation phase 30 years after their establishment.
Local partners	Municipality of Kikinda

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