

**GENERAL INFORMATION**

**Title of NAMA**

- ▶ **Construction of 9 new small hydropower plants (HPPs) in Serbia**

**Description**

- ▶ **Description of Mitigation Action**

The NAMA involves construction of 9 new small hydropower plants (HPP) throughout Serbia. The total capacity of 9HPP is 30.40 MW with possible electricity production of 108.3 GWh/year. All of the electricity generated will be supplied to the Serbian electricity grid, which is currently composed mostly of carbon-intensive lignite-fired thermal power plants.

The NAMA will contribute to climate change mitigation as the hydro power as renewable energy source does not emit any greenhouse gases (GHGs) during operation, and reduces GHGs that would otherwise be emitted from grid-connected power plants in the absence of the mitigation action.

Detailed list of HPPs is as below. Size of HPP varies from 0.5 MW to 11 MW.

**Table 1 List of HPPs**

N°	HPP name	Location	Watercourse	Capacity (MW)	Expected Generation (GWh/y)	Investment (Million €)
1	Rovni	Valjevo	Jablanica	1.25	5.2	1.612
2	Svrackovo	Arilje	Veliki Rzav	7.65	22	9.28
3	Jezero	Surdulica	Bozicki tunnel	1	4.85	2.98
4	Mala Vrla 1	Surdulica	Vrla, Gradska reka	0.47	1.83	0.8
5	Zavoj	Pirot	Visocica	0.58	2.94	1.112
6	W. s. Nis	Nis	Water supply Nis	4.9	4.88	1.0
7	Banjica	Sicevo	Nisava	2.3	12	5.9
8	Stalac	Stalac	Juzna Morava	11	48	29.0
9	Sokolja	Kraljevo	Sokolja, Gvozdacka reka	1.25	6.6	3.0
Total				<b>30.40</b>	<b>108.3</b>	<b>54.684</b>

► **Technology/ measure**

Technical specification varies among 9 HPPs as shown in the tables below.

Construction activities differ from plant to plant. The main difference is whether a dam has to be built or it already exists and can be used for the new HPP. Generally, civil structure and equipment for specified HPPs usually consist of: water pipeline (different length, diameter and installed discharge), turbine (Francis, Kaplan, Pelton type), generator set (one to four units), auxiliary equipment and control system.

9 HPPs can be categorized into three groups as follows:

- HPPs constructed on existing management facilities  
2 HPPs of this type will be built. Total construction investments cover only the HPPs construction.
- HPPs constructed using the water discharged from the existing HPPs  
The current plan is to build 2 HPPs of this type.
- HPPs constructed on new sites  
This group of HPPs has still not been analyzed in details, and that other possible sites may be included if, based on preliminary analyses, they are suitable for further consideration.

**Table 2 Technical specifications of 9HPPs**

HPP Name	Rovni	Svrackovo	Jezero
Nominal capacity	1.25 MW	7.65 MW	1.0 MW
Annual generation	5.2 GWh/year	22.0 GWh/year	4.85 GWh/year
Nominal head (m)	67 m	53.5 m	12 m
Discharge	Installed 2.1 m <sup>3</sup> /s, mean annual 1.341 m <sup>3</sup> /s	Installed 15.86 m <sup>3</sup> /s , mean annual 6.21 m <sup>3</sup> /s	Installed 8.0 m <sup>3</sup> /s , mean annual 3.9 m <sup>3</sup> /s
Number of turbines	3	3	2
Hydraulic turbines	Francis type	Francis type	Kaplan type
Dam type	Rock-fill dam with clay core, under reconstruction	Rock-fill dam with clay core	N/A
Available storage vol.	N/A	21 million m <sup>3</sup>	N/A
Total storage volume	49.5 million m <sup>3</sup>	27 million m <sup>3</sup>	N/A

HPP Name	Mala Vrla 1	Zavoj	Water supply Nis
Nominal capacity	0.47 MW	0.58 MW	4.9 MW
Annual generation	1.83 GWh/year	2.94 GWh/year	4.88 GWh/year
Nominal head (m)	42 m	80 m	47 - 133 m
Discharge	Installed 1.4 m <sup>3</sup> /s , mean annual 0.8 m <sup>3</sup> /s	Installed 0.9 m <sup>3</sup> /s,	Installed 0.65 m <sup>3</sup> /s , mean annual 0.65 m <sup>3</sup> /s
Number of turbines	2	1	4
Hydraulic turbines	Banky type	Francis type	Francis type
Dam type	Tyrol intake	Rock-fill dam with clay core	N/A
Available storage vol.	N/A	150 million m <sup>3</sup>	N/A
Total storage volume	N/A	180 million m <sup>3</sup>	N/A

HPP Name	Banjica	Stalac	Sokolja
Nominal capacity	2.3 MW	11 MW	1.25 MW
Annual generation	12.0 GWh/year	48 GWh/year	6.6 GWh/year
Nominal head (m)		7 m	
Discharge	Installed 45 m <sup>3</sup> /s ,	Installed 140 m <sup>3</sup> /s	Installed 0.92 m <sup>3</sup> /s
Number of turbines	2	2	2
Hydraulic turbines	Francis type	Kaplan type	Pelton type
Dam type	Low concrete gravitation dam	Low concrete gravitation dam with rock-fill section	
Available storage vol.	N/A	N/A	N/A
Total storage volume	N/A	N/A	N/A

## Location

- ▶ 9 different locations as shown in the map below.



**Figure 1 Location of HPPs**

## NAMA Implementing Entity

- ▶ Public Enterprise Electric Power Industry of Serbia (EPS)
- ▶ EPS is a 100% state-owned company whose main business include electric power generation and distribution, distribution system management, electric power trade, coal production, processing and transport, steam and hot water production in combined heating processes, water power utilization and services in river and lake traffic, wholesale trade in fuel and similar products. EPS operations also include research and development, design, construction and maintenance of energy and mining plants, design, construction and operation of telecommunication facilities and engineering.
- ▶ [www.eps.rs](http://www.eps.rs)

## Implementing Schedule

The project consists of two phases:

Phase I: Construction of 6 small scale hydropower plants in the area of existing hydro facilities

Phase II: Construction of 3 small scale hydropower plants in the new locations

## Expected starting date of Action

Information about Technical documentation and starting and finishing date of construction is given in the table 3.

**Table 3 Expected starting date of HPPs**

N°	HPP name	Expected timing of construction	Expected timing of operation	Status of preparation of documentation
1	Rovni	2014	2015	Conceptual design and Prefeasibility Study
2	Svrackovo	2013	2016	Main design and Construction licence
3	Jezero	2014	2015	Conceptual design and Prefeasibility Study
4	Mala Vrla 1	2014	2015	Conceptual design and Prefeasibility Study
5	Zavoj	2013	2014	Main design and Construction licence
6	W. s. Nis	2013	2014	Conceptual design and Prefeasibility Study
7	Banjica	N/A	N/A	2013 Preparation of Technical documentation
8	Stalac	N/A	N/A	2013 Preparation of Technical documentation
9	Sokolja	N/A	N/A	2013 Preparation of Technical documentation

## Lifetime

- ▶ 40 years

## Current Status

Explained in the Table 3 above.

## Coverage

- ▶ **Sector:** Renewable energy generation
- ▶ **GHG Gases:** CO<sub>2</sub>

**FINANCIAL INFORMATION**

**Finance and Cost**

- ▶ Expected cost of **preparation**:  
none (preparation and feasibility studies completed)  
Feasibility study for 6 HPPs has been completed and for 3 HPPs will be prepared in 2013 (see Table 3). EPS will incur cost for feasibility studies of HPPs, and other necessary technical documentation.
- ▶ Expected cost of **implementation**: EUR 54.684 million (for 9 HPPs)
- ▶ Expected **incremental cost** of implementation:  
none
- ▶ **Financial sources**:  
EPS equity and loan
- ▶ **Financial analysis**:  
Please find attachment for the financial analysis.  
  
Simple payback period: 12.1 years  
FIRR: 6.0% (for 40 years)  
NPV: - 9,130 EUR

**INFORMATION ON SUPPORT REQUIRED**

**Description of Support Required**

Type of Support	Support required for Preparation	Support required for implementation
<b>Financial</b>	x	54.684 million EUR (soft loan): for the initial investment cost for all 9 HPPs
<b>Technical</b>	x	x
<b>Capacity Building</b>	x	x

**EXPECTED GHG EMISSION REDUCTIONS AND MRV**

**Expected Mitigation Potential**

- ▶ **Annual reduction:** 102,343 tCO<sub>2e</sub>
- ▶ **Total reduction:** 4,093,720 tCO<sub>2eq</sub> (40 years)

**Methodologies and Assumptions (including BAU scenario)**

- ▶ **Methodology:** Approved CDM methodology, AMS-I.D. "Grid connected renewable electricity generation" is applied to estimate emission reductions from the NAMA.
- ▶ **BAU scenario:** new small HPPs (9 plants) are not constructed and instead grid-connected power plants, mainly thermal power plants, continue operation and supply electricity to the grid.

▶ **Calculation of emission reductions:**

$$BE = EG_{\text{baseline}} * EF_{\text{grid}}$$

Where

BE = baseline GHG emissions

EG<sub>baseline</sub> = electricity generation at baseline BAU case

EF<sub>grid</sub> = emission factor of the electricity grid

<b>Data / Parameter</b>	EG <sub>baseline</sub>
Unit	MWh
Description	Quantity of electricity supplied to the grid by 9 HPPs which in the absence of the NAMA would have been sourced from the grid
Value applied	108,3 MWh/yr
Source of data	Estimated based on the manufacturer's specification and expected plant factor provided by NAMA implementing entity
Comment	Plant factor varies on each HPP

<b>Data / Parameter</b>	EF <sub>grid</sub>
Unit	t-CO <sub>2</sub> /MWh
Description	CO <sub>2</sub> emission factor of the grid
Source of data	Official data provided by Serbian Ministry of Environment, Mining and Spatial Planning, which is a

	Designated National Authority for CDM.
Value applied	0.945 tCO <sub>2</sub> /MWh
Comment	Emission factor was calculated in accordance with the CDM guidance "Tool to calculate the emission factor for an electricity system" and Serbia's official data was used. Simple OM calculation option is applied for Operating Margin calculation. Data years are 2008, 2009, and 2010.  <a href="http://www.ekoplan.gov.rs/DNA/index_en.html">http://www.ekoplan.gov.rs/DNA/index_en.html</a>

$$\begin{aligned} BE &= 108,300 \text{ MWh} * 0.945 \text{ tCO}_2/\text{MWh} \\ &= 102,343 \text{ t-CO}_{2\text{eq}} \end{aligned}$$

## Measurement, Reporting, and Verification (MRV)

### Monitoring Plan

#### ► Data and parameters to be monitored:

Following two parameters will be monitored in order to calculate emission reductions from the NAMA.

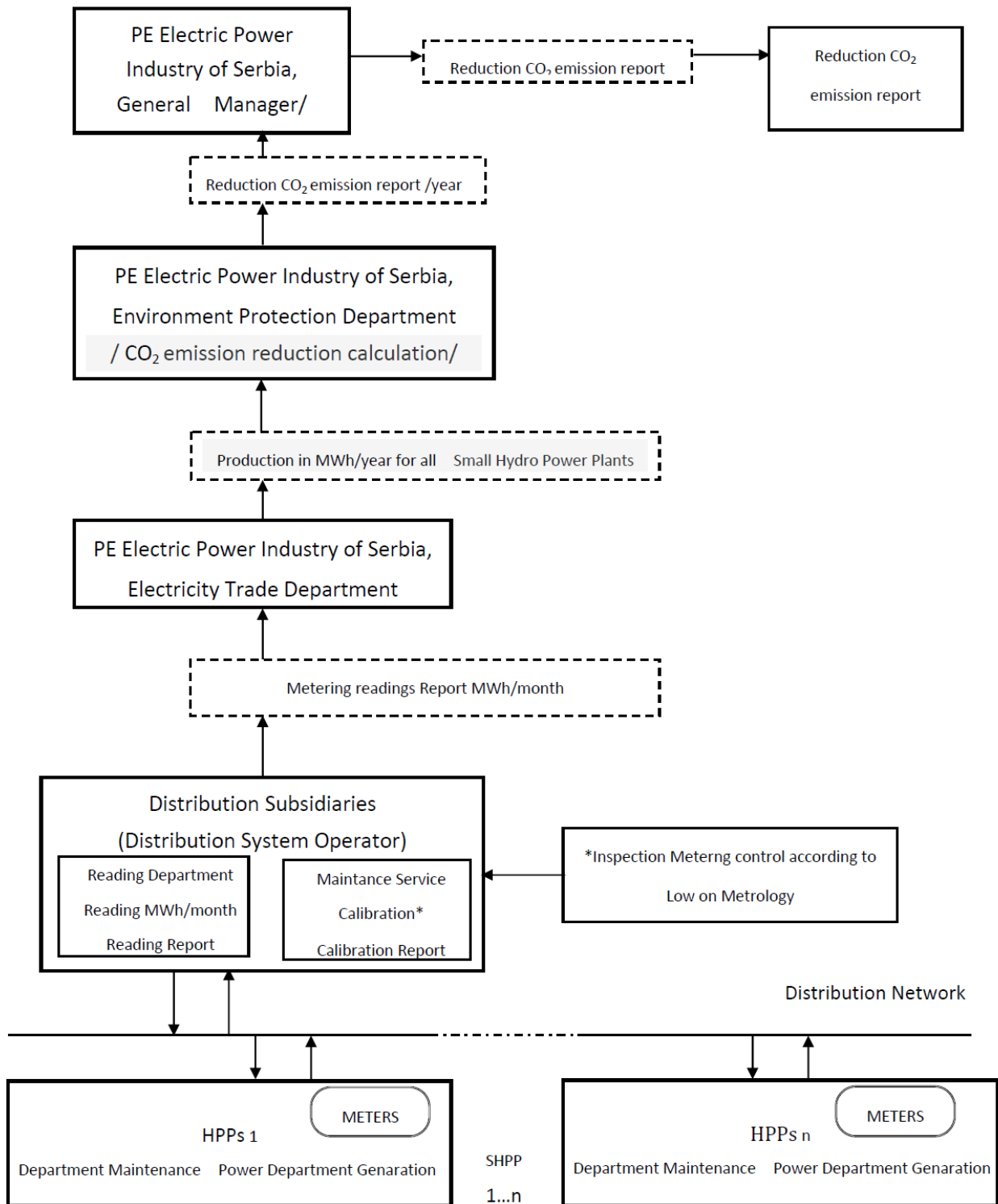
<b>Data / Parameter</b>	EG <sub>v</sub>
Unit	MWh
Description	Quantity of electricity supplied to the grid by 9 HPPs
Source of data	Operation centre at generation system
Measurement procedures	Measured continuously by electricity meter equipped at each of the HPPs and recorded daily.
Monitoring frequency	Monthly Compiled and aggregated data is recorded on computer.
QA/QC procedures	The electricity meters will be periodically calibrated according to the relevant national industrial standards and regulations. Meter readings will be compared to electricity sales receipts.

<b>Data / Parameter</b>	EF <sub>grid</sub>
Unit	t-CO <sub>2</sub> /MWh
Description	CO <sub>2</sub> emission factor of the grid
Source of data	Official data provided by Serbian Ministry of Energy, Development and Environmental Protection
Measurement procedures	Website of Serbian Ministry of Minister of Energy, Development and Environmental Protection is checked for an update.
Monitoring frequency	Yearly
QA/QC procedures	No QA/QC necessary for this data item.

#### ► Monitoring plan and structure:

Monitoring of the data and parameters above will be conducted based on the EPS monitoring structure shown below. Monitoring activities will be conducted by EPS, the NAMA implementing entity, based on its ISO 9001:2008 certified quality management system.





**Monitoring Structure of NAMA**

Calibration \* - Verification and benchmarking meters are calibrated by accredited Metrology laboratories, which are accredited by the Accreditation Body of Serbia (ATS).

The Distribution System Operator must take care that all meters in his ownership be verified and calibrated in time and in the manner prescribed by the Law on Metrology, according to meters class.

All the meters for the calculation of generation / consumed electricity are ownership of Distribution system operators, including meters in the HPPs. Monthly reading generation/consumption of electricity is done by Distribution system operator on a monthly basis.

Reporting course:

- After metering readings of electricity generation in HPPs, all Distribution system operators - Distribution Subsidiaries submit monthly reports PE Electric Power Industry of Serbia, to Electricity Trade Department for the calculation and payment of electricity delivered.
- PE Electric Power Industry of Serbia, Electricity Trade Department, based on monthly reports at the request of the common functions of PE Electric Power Industry of Serbia, Environmental Protection section submit the data for delivered and calculated electricity production on a annually base from HPP.
- Common functions of PE Electric Power Industry of Serbia, Environmental Protection section include CO<sub>2</sub> emissions reduction calculation based on data obtained from Electricity Trade Department on an annual basis and deliver to General Manager of PE Electric Power Industry of Serbia/ Board of Directors.
- PE Electric Power Industry of Serbia submit CO<sub>2</sub> Emission Reduction Monitoring Report to Verification authorities.

Accuracy control:

- Verification and calibration standards of meters shall be subject to such terms and in the manner specified by regulatory law, by an accredited laboratory, on which a Distribution system operator shall maintain proper records.
- In case of conflict or doubt that there is a conflict in the read values assumed for calculation of delivered electric energy, all participants in the generation, reading and calculation of electric energy the HPP may request that the Commission establish the accuracy of the readings or calculated data, in accordance with long-term contracts.

Considering the abundant experience of EPS in operating hydro projects, the current monitoring system should be able to be applied to these 9 HPPs. Republic of Serbia soon will start the process of harmonization with EU Emission trading system, that include MRV system.

### **Domestic MRV arrangements**

- ▶ Domestic MRV arrangement of Serbia is currently under development.
- ▶ It is expected that under the Serbian domestic MRV system, a NAMA implementing entity is responsible for the Measurement (M) and Reporting (R) activities, which will go through Verification (V) from third party.
- ▶ It is expected that the MRV of HPP NAMA will be conducted in the following manner.
  1. EPS will conduct the Measurement activity based on the above-mentioned monitoring plan in order to calculate the emission reductions achieved by the NAMA.
  2. EPS will prepare a Report that contains information on 1) the detailed result of the monitoring activities conducted based on the monitoring plan, 2) the result of emission reduction calculation based on the above mentioned methodology, and 3) any support received under NAMA scheme from Annex-I countries or international organization regarding financial support, technical support, or support on capacity building.

### **OTHER INFORMATION**

#### **Contribution to Sustainable Development**

- ▶ "Energy Sector Development Strategy Of the Republic of Serbia by 2015" lists in its priority activity, the program of selective use of New Renewable Energy Sources, including small and mini hydropower plants – facilities of up to 10 MW.
- ▶ The NAMA is expected to contribute to sustainable development of Serbia and co-benefit in the following manners.
  - Utilization of renewable energy sources
  - Reduction of impact on environment
  - Creation of local employment opportunities
  - Awareness raising among general public about clean energy
  - Mitigation of CO<sub>2</sub> emissions

#### **Stakeholder consultation**

- ▶ EPS will conduct a public stakeholder consultation regarding the NAMA. At the consultation, objective and outcome, expected impacts on local environment, employment opportunities, etc. will be presented to stakeholders, and their comments will be collected and compiled.
- ▶ EPS will take necessary due accounts to the comments received during the public consultation and report the results.
- ▶ Public consultation will be held either through website or meetings near the project site.

PE EPS regularly conducts a public consultation before commercial operation of HPPs, and that procedure will be applied to new 9 HPPs projects. This procedure will be according to EIA Law and Law on information and Law on implementation of Aarhus Convention.

**CONTACT INFORMATION**

**NAMA Implementing Entity**

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**NAMA Coordinating Entity**

Entity Name	Ministry of Energy, Development, and Environmental Protection Climate Change Division
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**Attachment: Financial Information**

No	HPP Name	Location	Power [MW]	Expected production [GWh/y]	Investment k€	Yearly Income 12Y FIT k€	IRR (40 years)	NPV k€	Pay Back Period (years)
1	Rovni	Valjevo	0.77	5.20	1,612	323.69	19.4%	1,756	8.0
2	Svrackovo	Arilje	7.65	22.00	9,280	1,288.10	10.3%	1,800	10.2
3	Jezero	Surdulica	1.00	4.85	2,980	301.91	5.7%	-490	12.9
4	Mala Vrla 1	Surdulica	0.47	1.83	800	117.30	12.9%	315	9.8
5	Zavoj	Pirot	0.58	2.94	1,112	183.01	14.6%	628	9.1
6	W. s, Nis	Nis	4.90	4.88	1,000	312.81	30.9%	2,350	6.2
7	Banjica	Sicevo	2.30	12.00	5,900	702.60	7.7%	-135	11.4
8	Stalac	Stalac	11.00	48.00	29,000	2,400.00	1.3%	-15,919	15.1
9	Sokolja I&II	Kraljevo	1.25	6.60	3,000	410.84	11.1%	756	10.3
<b>Whole 9 Projects</b>			<b>29.92</b>	<b>108.30</b>	<b>54,684</b>	<b>6,040.27</b>	<b>6.0%</b>	<b>-9,130</b>	<b>12.1</b>

Assumptions:

- 1) Feed In Tariff is applied for the first 12 years of operation in accordance with the "Decree on Incentive Measures for Electricity Generation Using Renewable Energy Sources and for Combined Heat and Power (CHP) Generation"
- 2) From the 13th year from operation, electricity sales price is set as 5 €/kWh
- 3) Life time 40 years, O&M cost 5% of total investment, construction period 3 years
- 4) Discount rate; 8%