Doc. No. 10-462-H6
Rev. 0 - JUNE 2011

Serbian Ministry of Environment, Mining and Spatial Planning Belgrade, Serbia

Technical Assistance for the Revision of Project Design Documents (PDDs)

Calculation of the Carbon Emission Factor for the Serbian Power Grid

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

TECHNICAL ASSISTANCE FOR THE REVISION OF PROJECT DESIGN DOCUMENTS (PDDS) CALCULATION OF THE CARBON EMISSION FACTOR FOR THE SERBIAN POWER GRID

1 INTRODUCTION

The Serbian Ministry of Environment and Spatial Planning (MESP) and the Italian Ministry for Environment, Land and Sea (IMELS) on September 3rd, 2002 signed a Memorandum of Understanding (MoU) on the "Environmental Protection Cooperation".

Within this framework, D'Appolonia S.p.A. (D'Appolonia) has been awarded by the MESP to provide specialized services related to the "Technical Assistance for Revision of the Project Design Documents (PDDs) submitted following the Calls for Expression of Interest for Receiving Co-Financing for the Preparation of PDDs" project (hereafter the Project). Over the last year, 4 PDDs has been analyzed and evaluated. During this activity, it was noted that different national Carbon Emission Factors (CEF) have been used in order to calculate the GHG emission reduction related to grid electricity displacement.

In light of this, MESP appointed D'Appolonia to perform the calculation of the Serbian grid CEF according to the "Tool to calculate the emission factor for an electricity system" (Tool) approved by UNFCCC. The result will set the national benchmark for all ongoing and future CDM project activities.

This report provides a comprehensive overview of the activities undertaken by D'Appolonia and final results.

This document is organized as follows:

- Section 2 defines a national grid carbon emission factor and the UNFCCC calculation tool;
- Section 3 illustrates data provided by Elektroprivreda Srbije (EPS), the Electric Power Industry of Serbia;
- Section 4 shows the CEF calculation;
- Section 5 summarizes the contents of the document.

2 THE KYOTO PROTOCOL

2.1 CLIMATE CHANGE AND CLEAN DEVELOPMENT MECHANISM (CDM)

United Nations Framework Convention on Climate Change (UNFCCC) was established in 1992 and entered into force on March 20th, 1994; it is an international treaty with the objective of stabilizing greenhouse gas (GHG) concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. It splits the countries into two categories: Annex I parties (OECD + EIT countries, with legally binding GHG emission reduction commitments) and Non-Annex I parties (with no GHG emission restrictions).

Kyoto Protocol, which is a legal binding commitment for the reduction of six greenhouse gases produced by Annex I nations, states that Annex I countries have to reduce their collective GHG emissions by at least 5.2% with respect to the year 1990 between 2008 and 2012. Kyoto Protocol was adopted on December 11th 1997, and entered into force on February 16th, 2005.

In order to assist Annex I nations to meet their emission reduction targets, the Kyoto Protocol defines three "flexibility mechanisms", namely Emission Trading (ET), Clean Development Mechanism (CDM), and Joint Implementation (JI).

These mechanisms enable Parties to access cost-effective opportunities to reduce emissions, or to remove carbon dioxide from the atmosphere, in other countries. While the cost of limiting emissions varies considerably from region to region, the effect for the atmosphere of limiting emissions is the same, irrespective of where the action is taken.

CDM is proposed under article 12 of the Kyoto Protocol, that allows Annex I nations with GHG reduction commitment to invest in projects that reduce emissions in Non-Annex I nations as an alternative to high cost emission reduction in their own countries. Simultaneously, CDM is also an important means to promote foreign investments and sustainable development in developing countries.

As of today, Serbia is a Non-Annex I party. As such Serbia can host CDM projects.

2.2 CARBON EMISSION FACTOR OF SERBIAN POWER GRID

CDM projects can be developed in a number of sectors like energy generation, energy efficiency, waste management, land use and agriculture. The basic principle underling the CDM is that the implementation of a CDM project must lead to a GHG emission reduction below a business-as-usual level (so called emission baseline). Projects involving the reduction of national grid electricity consumption (e.g. energy efficiency projects) or its displacement (e.g. grid-connected renewable energy generation projects) will lead to a GHG emission reduction which has to be properly quantified. This can be done by multiplying the amount of avoided grid electricity generation by the national grid Carbon Emission Factor (CEF). A carbon emission factor is defined as the amount of GHG emitted by a specific process, fuel, equipment, or source. The CEF of a fuel shows how much carbon will be released per unit of potential energy. Different fossil fuels (coal, oil, natural gas, etc.) present different CEF values; the lower the value, the less carbon is released per unit of energy.

Similarly to fossil fuels, also the CEF of electricity production can be calculated. In a thermoelectric power plant, a quantity of fuel must be consumed to produce a certain amount of electric energy, so that, knowing the characteristics of the fuel used and of the plant, it is possible to calculate the CEF of power production in terms of amount of CO_2

emitted per unit of generated energy. Figure 2.1 provides an idea of greenhouse emissions coming from different types of power plants (IPPC, 2006). Of course, power plants not using fossil fuels like nuclear or renewable power plants, do not cause emissions, and have a CEF equal to zero or very small in case plant operations entail direct or indirect fossil fuel combustion (i.e.: for transportation purposes).

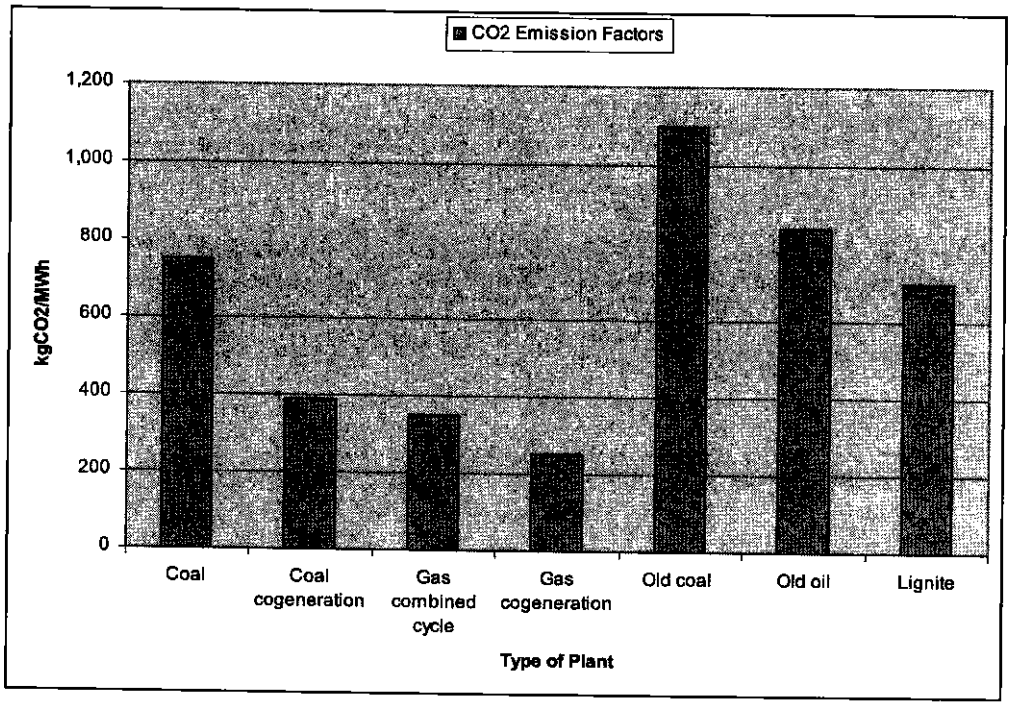

Figure 2.1: CO_2 Emission Factors for Different Types of Combustion Plants

Based on the emission factors of single plants, it is possible to calculate the emission factor of a national power grid, as the average of the CEF of each operating power plant weighted on its energy production (see Section 3 for data collection). This is usually done over a period of 3 years.

The CDM Executive Board has approved a set of methodologies and tools to correctly calculate the emission factor of a national grid, in order to standardize the methods to assess their effect in terms of greenhouse gases production.

The CEF is calculated using the procedure reported in the "Tool to calculate the emission factor for an electricity system". This methodological tool determines the CO_2 emission factor for the displacement of electricity generated by power plants in an electricity system, by calculating the "Combined Margin" emission factor (CM) of the electricity system. The CM is the result of a weighted average of two emission factors pertaining to the electricity system: the "Operating Margin" (OM) and the "Build Margin" (BM).

The OM is the emission factor that refers to the group of existing power plants whose current electricity generation would be affected by the proposed CDM project activity. The BM is the emission factor that refers to the group of prospective power plants whose construction and future operation would be affected by the proposed CDM project activity.

Section 4 will provide a detailed description of the tool as well as the actual calculation of the Serbian national grid emission factor.

3 DATA COLLECTION AND ANALYSIS

For the CEF calculation several data relevant to the power plants are needed, such as yearly electricity productions, fuel type and fuel consumptions, and the commissioning year. To this end, D'Appolonia team provided EPS with a data request list to be filled. Data are relevant to the three most recent years: 2008, 2009 and 2010.

EPS provided a detailed and precise list of power plants including installed MW, electricity productions, fuel type, fuel net calorific value and fuel consumptions, commissioning year, operational status.

It should be noted that the TPP plants (i.e.: TPP Nikola Tesla A1÷A6, TPP Kolubara A1÷A5, TPP-HP Novi Sad A1÷A2, etc.) are fed with a two different fuel mixes, coal and heavy fuel oil, or heavy fuel oil and gas (depending on which fuel is preponderant). In the CEF calculation D'Appolonia took into account, for all these plants, the two different kinds of fuels and the relevant consumptions.

For some TPP-HP power plants such as TPP-HP Novi Sad A1÷A2, TPP-HP Zrenjanin A1÷A2, TPP-HP Sremska Mitrovica A1/A3 and Toplana Vreoci thermal energy production data were provided ($GWh_{thermal}/y$). These values were not taken into account in the CEF calculation because they are not electricity production data.

It is also important to point out some data gaps and inconsistencies deriving from an analysis of the power plants data provided by EPS, in particular:

1. concerning TPP-HP Zrenjanin A1 ÷ A2 plants fed with heavy fuel oil, for year 2010 the total electricity produced by the two plants is about 12 GWh/y, while the corresponding total fuel consumption is zero;
2. the electricity produced by TPP-HP Sremska Mitrovica A1/A3 plants fed with heavy fuel oil is very little (0.74 and 0.94 GWh/y) if compared with the electricity produced by the other plants (from 100 to 10,000 GWh/y). Moreover, the fuel consumption for year 2010 (19 t/y) is much lower than the fuel consumptions of the other two years (1,283 and 1,789 t/y);
3. EPS did not provide data for electricity imports for the abovementioned three years. D'Appolonia used the following electricity import data derived from Index Mundi, Serbia Electricity Imports website:

- Year 2008 and 2009: 11,230 GWh/y,
- Year 2010: 121 GWh/y;

It should also be noted that the electricity import of year 2010 is much lower than the imports of the previous two years.

For more details concerning power plants data, please refer to Appendix A – List of Serbian Power Plants.

4 CALCULATION OF THE CEF FOR THE SERBIAN POWER GRID

The CEF of the Serbian National grid is calculated according to the "Tool to calculate the emission factor for an electricity system" and taking into consideration the energy data (energy production, fuel consumption, etc.) of the power plants provided by EPS for years 2008, 2009 and 2010.

The current Serbian energy situation is characterized by a preponderance of fossil fuel fired power plants in comparison with the contribution from renewable energy plants, namely hydro power plants. Most of the fossil fuel plants are fuelled by coal, heavy fuel oil and natural gas and their energy production ranges between 1 GWh/y up to about 10,000 GWh/y (see Appendix A).

UNFCCC "Tool to calculate the emission factor for an electricity system" should be used in order to determine the emission factor for the displacement of electricity generated by the power plants within the national power grid of Serbia.

The CEF is determined by calculating three components of the power grid, namely:

- Operating margin (OM) – the existing power plants whose electricity generation would be affected by the proposed CDM project;
- Build margin (BM) – the type of power units whose construction would be affected by the proposed CDM project;
- Combined margin (CM): 50% of OM and 50% of BM.

The calculation is carried out according to the following steps:

1. Identify the relevant electric grid

National Grid of Serbia (there is only one power grid in Serbia).

2. Select an OM method

The evaluation of OM depends on the choice of the most suitable option for the project case. Four options are available: simple OM, simple adjusted OM, dispatch data analysis OM and average OM.

Since low-cost/must-run resources[1] (coal has not been considered a must-run resource) represent less than 50% of the overall energy production for the Country, the simple OM approach has been chosen. According to this assumption, the calculation has been carried out including only the fossil fuel fired power plant, excluding the so called "low cost/must run plants".

[1] Low-cost/must-run resources are defined as power plants with low marginal generation costs or power plants that are dispatched independently of the daily or seasonal load of the grid. They typically include hydro, geothermal, wind, low-cost biomass, nuclear and solar generation. If coal is obviously used as must-run, it should also be included in this list, i.e. excluded from the set of plants.

For the simple OM, the simple adjusted OM and the average OM, the emissions factor can be calculated using either of the two following data vintages:

- ex ante option: if the ex ante option is chosen, the emission factor is determined once at the validation stage, thus no monitoring and recalculation of the emissions factor during the crediting period is required. For grid power plants, use a 3-year generation-weighted average, based on the most recent data available at the time of submission of the CDM-PDD to the DOE for validation. For off-grid power plants, use a single calendar year within the 5 most recent calendar years prior to the time of submission of the CDM-PDD for validation;
- ex post option: if the ex post option is chosen, the emission factor is determined for the year in which the project activity displaces grid electricity, requiring the emissions factor to be updated annually during monitoring. If the data required to calculate the emission factor for year y is usually only available later than six months after the end of year y, alternatively the emission factor of the previous year y-1 may be used. If the data is usually only available 18 months after the end of year y, the emission factor of the year proceeding the previous year y-2 may be used. The same data vintage (y, y-1 or y-2) should be used throughout all crediting periods.

In this analysis the ex-ante option approach has been chosen, i.e. a 3-year generation-weighted average emissions per electricity unit (tCO_2/MWh) of all generating sources serving the system (latest data), not including low-operating cost and must-run power plants/units.

3. Calculate the OM emission factor

The simple OM emission factor is calculated according to the Option A, based on the net electricity generation of each power unit and an emission factor for each power unit, as follows:

$$EF_{grid,OMsimple,y} = \frac{\sum_{i,m} EG_{m,y} \cdot EF_{EL,m,y}}{\sum_{m} EG_{m,y}}$$

where:

$EF_{grid,OMsimple,y}$ = Simple operating margin CO_2 emission factor in year y (tCO_2/MWh)

$EG_{m,y}$ = Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)

$EF_{EL,m,y}$ = CO_2 emission factor of each power unit m in year y (tCO_2/MWh)

m= all power units serving the grid in year y except low-cost/must-run power units

y= the relevant year according to the ex-ante option

$EF_{EL,m,y}$, is calculated according to the Option A1 based on data on fuel consumption and net electricity generation of each power plants/units:

$$EF_{EL,m,y} = \frac{\sum_{i,m} FC_{i,m,y} \cdot NCV_{i,y} \cdot EF_{CO2,i,y}}{\sum_{m} EG_{m,y}}$$

where:

$EF_{EL,m,y}$ = CO_2 emission factor of each power unit m in year y (tCO_2/MWh)

$FC_{i,m,y}$ = Amount of fossil fuel type i consumed by power plant m in year y (mass or volume unit)

$NCV_{i,y}$ = Net calorific value (energy content) of fossil fuel type i in year y (GJ/mass or volume unit)

$EF_{CO2,i,y}$= CO_2 emission factor of fossil fuel type i in year y (tCO_2/GJ)

$EG_{m,y}$ = Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)

m = All power plants/units serving the grid in year y except low-cost/must-run power plants/units

i = all fossil fuel types combusted in power plant/unit m in year y

y = the relevant year according to the ex-ante option

The following data for emission factor of fuel, derived from the Intergovernmental Panel on Climate Change (IPCC) Guidelines (IPCC, 2006), were used for the calculation:

$EF_{CO2,coal,y}$ = 101,000 $kgCO_2/TJ$

$EF_{CO2,heavy\ fuel\ oil,y}$ = 77,400 $kgCO_2/TJ$

$EF_{CO2,oil,y}$ = 74,100 $kgCO_2/TJ$

$EF_{CO2,natural\ gas,y}$ = 56,100 $kgCO_2/TJ$

The Simple Operating Margins calculated for years 2008, 2009 and 2010 are respectively:

Year 2008: Simple OM = 940 t CO_2 /GWh;

Year 2009: Simple OM = 905 t CO_2 /GWh;

Year 2010: Simple OM = 1,119 t CO_2 /GWh.

The Weighted Average $OM_{EFgrid,OM,y}$ is: 984.8 t CO_2/GWh = **0.985 t CO_2 /MWh**

4. *Identify the cohort of power units to be included in the BM:*

- set of 5 power units is chosen, as it is the same as the set of power capacity additions in the electricity system that comprise 20% of the system generation;
- power plants registered as CDM project activities should be excluded from the sample group m.

5. *Calculate the BM emission factor*

The BM emission factor is the generation-weighted average emission factor (tCO_2/MWh) of all power units m during the most recent year y for which power generation data is available; it includes data about the set of power capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently. BM has been calculated as follows:

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}}$$

where:

$EF_{grid,BM,y}$ = Build Margin CO_2 emission factor in year y (tCO_2/MWh)

$EG_{m,y}$ = Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)

$EF_{EL,m,y}$ = CO_2 emission factor of power unit m in year y (tCO_2/MWh)

m = Power units included in the build margin

y = Most recent historical years for which power generation data is available

The CO_2 emission factor of each power unit m ($EF_{EL,m,y}$) is determined as in the OM calculation.

Table 4.1 shows the information of the power plants recently built in Serbia, to be included in the sample group for BM calculation.

Table 4.1: Recently Built Power Plants

Power Plant	Commissioning Date	Capacity (MW)	Average Electricity Production (GWh)	Fuel consumption (kt)
TPP Nikola Tesla B2	1985	620	3,900	5,530
TPP Kostolac B1/B2	1987, 1991	680	3,306	4,530
TPP-HP Zrenjanin A1/A2	1989	110	41	6
HPP Djerdap II	1985-87, 1998, 2001	270	1,520	-
HPP Pirot	1990	80	138	-
Total		**1,760**	**8,905**	**10,066**

The Build Margins calculated for years 2008, 2009 and 2010 are respectively:

Year 2008: *BM=889 t CO_2 /GWh;*

Year 2009: *BM= 932 t CO_2 /GWh;*

Year 2010: *BM= 894 t CO_2 /GWh.*

The Weighted Average BM, $EF_{grid,BM,y}$ is: 905.2 t CO_2 /GWh = **0.905 t CO_2/MWh**

6. Calculate the CM emission factor

The CM emission factor is calculated as follows:

$$EF_{grid,CM,y} = EF_{grid,BM,y} * w_{BM} + EF_{grid,OM,y} * w_{OM}$$

where:

$EF_{grid,BM,y}$ = BM CO_2 emission factor in year y (tCO_2/MWh)

$EF_{grid,OM,y}$ = OM CO_2 emission factor in year y (tCO_2/MWh)

w_{OM} = Weighting of OM emission factor (%)

w_{BM} = Weighting of BM emission factor (%)

The following data were used for the calculation:

- $EF_{grid,BM,y}$ = 0.905 tCO_2/MWh. This is the calculated value from BM section
- $EF_{grid,OM,y}$ = 0.985 tCO_2/MWh. This is the calculated value from OM section

- w_{OM} = 0.5. This is the default value in accordance with the methodology tool.
- w_{BM} = 0.5 This is the default value in accordance with the methodology tool.

Hence, according to the Tool and to the abovementioned assumptions:

$$\mathbf{EF_{grid,CM,y} = 0.945\ tCO_2/MWh}$$

This value, which represents the Carbon Emission Factor of Serbian national power grid, will be used in the estimation of the carbon emission reductions in the Country.

For more detail concerning the CEF calculation make reference to the Appendix B – Serbian CEF Calculation.

5 CONCLUSIONS

The main task of this report is to calculate the Carbon Emission Factor (CEF) of the electricity grid in Serbia in accordance with the "Tool to calculate the emission factor for an electricity system" (="Tool") of the UNFCCC. The Grid CEF is the amount of carbon dioxide emissions associated with each unit of electricity in an electricity grid [tonsCO_2/MWh]. The national grid CEF is a crucial parameter to calculate Certified Emission Reductions (CERs) under the CDM mechanism. Given that each grid has a different mix of various sources (renewable, thermal and nuclear) of power, CEF might differ considerably from country to country. A high CEF gives an additional incentive to project developers to realize energy-related CDM projects since an additional revenue stream can be generated by the sale of CERs on the market.

The Tool determines the CO_2 Emission factor for the displacement of electricity generated by power plants in an electricity system, by calculating the "Operating Margin" (OM) and "Build Margin" (BM) as well as the "Combined Margin" (CM). The combined Margin (CM) is calculated in multi step approach described under Section 4.

All the necessary data were provided by the Electric Power Industry of Serbia. It must be pointed out that the analysis still presents some data gaps like figures on electricity imports (taken from a secondary source) and some inconsistencies in the electricity production and fuel consumption data.

The results of the calculation of the Combined Margin (CM) Emission Factor are presented in Section 4 of this document. The CEF for the Serbian national grid turned out to be 0.945 tCO_2/MWh.

Serbian authorities are now able to adopt a single national grid CEF to be provided to current and future CDM project proponents. This study represents a critical step in terms of Serbian credibility with potential CDM investors, for which clear and effective national procedures are of paramount importance to plan investments.

MBT/CRB/GIC/PAR/MGC:mcs

REFERENCES

CDM Executive Board, 2011, "Methodological Tool – Tool to Calculate the Emission Factor for an Electricity System", Version 02.1.0

Index Mundi, Serbia Electricity Imports, website: http://www.indexmundi.com/serbia/electricity_imports.html

Integrated Pollution Prevention and Control (IPPC), 2006, "Reference Document on Best Available Techniques for Large Combustion Plants", July 2006.

Intergovernmental Panel on Climate Change (IPCC), 2006, "2006 IPCC Guidelines for National Greenhouse Gas Inventories".

APPENDIX A
LIST OF SERBIAN POWER PLANTS

APPENDIX A - LIST OF SERBIAN POWER PLANTS

POWER PLANTS	POWER (MW); *(MW$_t$) ^{1}(t/h)	COMMISSIONING YEAR	PLANT IN OPERATION YES / NO	FUEL	NET CALORIFIC VALUE (MWh/t) or (GJ/t)			ELECTRICITY PRODUCTION (GWh/y) (**GWh/y)			FUEL CONSUMPTION (t/y); (m^3/y)		
					2008	2009	2010	Year 2008	Year 2009	Year 2010	Year 2008	Year 2009	Year 2010
TPP NIKOLA TESLA A 1	210	1970	YES	Coal	8.034	7.922	7.445	1,291.1	1,118.4	1,168.9	1,872,116	1,636,095	1,777,848
TPP NIKOLA TESLA A 2	210	1970	YES		8.034	7.922	7.445	1,175.3	1,262.9	1,058.9	1,703,228	1,846,153	1,609,747
TPP NIKOLA TESLA A 3	305	1976	YES		8.034	7.922	7.445	1,965.0	1,825.9	1,646.3	2,844,115	2,660,987	2,502,703
TPP NIKOLA TESLA A 4	308.5	1978	YES		8.034	7.922	7.445	2,222.1	2,051.1	1,938.9	3,214,820	2,992,013	2,944,782
TPP NIKOLA TESLA A 5	308.5	1979	YES		8.034	7.922	7.445	2,023.3	1,945.3	1,906.9	2,928,026	2,839,536	2,897,997
TPP NIKOLA TESLA A 6	308.5	1979	YES		8.034	7.922	7.445	1,003.6	1,972.1	860.9	1,456,257	2,879,571	1,320,590
TOTAL	**1,650.5**							**9,680.4**	**10,175.7**	**8,580.8**	**14,018,562**	**14,854,355**	**13,053,667**
TPP NIKOLA TESLA A 1				Heavy fuel oil	39.000	39.000	39.000				3,814	3,676	3,687
TPP NIKOLA TESLA A 2					39.000	39.000	39.000				2,094	2,469	3,120
TPP NIKOLA TESLA A 3					39.000	39.000	39.000				3,659	2,848	3,290
TPP NIKOLA TESLA A 4					39.000	39.000	39.000				8,953	5,924	5,434
TPP NIKOLA TESLA A 5					39.000	39.000	39.000				5,065	5,698	5,780
TPP NIKOLA TESLA A 6					39.000	39.000	39.000				4,257	3,039	6,453
TOTAL											**27,842**	**23,654**	**27,764**
TPP NIKOLA TESLA B 1	620	1983	YES	Coal	7.801	7.768	7.429	4,509.5	4,116.3	3,641.1	6,262,556	5,858,825	5,281,353
TPP NIKOLA TESLA B 2	620	1985	YES		7.801	7.768	7.429	3,867.7	3,323.1	4,472.2	5,373,146	4,728,422	6,480,212
TOTAL	**1,240**							**8,377.1**	**7,439.3**	**8,113.3**	**11,635,702**	**10,587,247**	**11,761,565**
TPP NIKOLA TESLA B 1				Heavy fuel oil	39.000	39.000	39.000				4,106	4,798	7,058
TPP NIKOLA TESLA B 2					39.000	39.000	39.000				5,330	4,847	9,471
TOTAL											**9,436**	**9,645**	**16,529**
TPP KOLUBARA A 1	35	1956	YES	Coal	7.719	6.689	6.694	179.9	182.3	183.4	1,006,763	1,334,997	397,760
TPP KOLUBARA A 2	35	1957	YES		7.719	6.689	6.646	144.4	56.2	128.3			305,280
TPP KOLUBARA A 3	35	1961	YES		7.719	6.689	6.684	0.0	213.4	159.1			198,790
TPP KOLUBARA A 4	55	1961	YES		7.719	6.689	6.710	148.6	107.0	0.0			232,530
TPP KOLUBARA A 5	110	1979	YES		7.505	6.689	6.618	618.2	270.0	610.0	1,100,769	529,667	1,162,450
TOTAL	**270**							**1,091.0**	**829.0**	**1,080.9**	**2,107,532**	**1,864,664**	**2,296,810**
TPP KOLUBARA A 1				oil	42.226	42.267	42.2058				1,449	1,855	992
TPP KOLUBARA A 2					42.226	42.267	42.2058						598
TPP KOLUBARA A 3					42.226	42.267	42.2058						631
TPP KOLUBARA A 4					42.226	42.267	42.2058						731
TPP KOLUBARA A 5					42.226	42.222	42.2058						
TOTAL											815	863	1,320
TPP MORAVA A 1	**110**	1969	YES	Coal	8.475	8.630	8.426	**635.8**	**539.1**	**578.3**	**2,364**	**2,718**	**4,272**
TPP MORAVA A 1				Heavy fuel oil	39.000	40.729	40.997				**802,822**	**697,941**	**778,865**
TPP MORAVA A 1				oil	42.226	42.474	40.997				**1,514**	**1,387**	**1,831**
TPP KOSTOLAC A 1		1967	YES	Coal	8187	8.202	8.085	551.7	601.1	574.7	**154**	**269**	**248**
TPP KOSTOLAC A 2		1980	YES		8.150	8.198	8.088	1,313.4	1,309.5	1,313.2	907,498	957,421	916,672
TOTAL								**1,865.1**	**1,910.6**	**1,887.9**	1,970,068	1,869,872	1,949,629
TPP KOSTOLAC A 1	100			oil	42.000	42.000	42.000				**2,877,566**	**2,827,293**	**2,866,301**
TPP KOSTOLAC A 2	210				42.000	42.000	42.000				1,150	912	707
TOTAL	**310**										1,153	902	768
TPP KOSTOLAC B 1	350	1987	YES	Coal	8.012	8.141	8.093	1,422.5	1,973.8	2,012.2	**2,303**	**1,814**	**1475**
TPP KOSTOLAC B 2	330	1991	YES		8.323	8.140	8.083	1,589.1	2,013.1	908.6	1,940,775	2,731,316	2,758,583
TOTAL	**700**							**3,011.6**	**3,986.9**	**2,920.9**	2,099,983	2,790,128	1,269,260
TPP KOSTOLAC B 1				Heavy fuel oil	41.001	41.001	41.001				**4,040,758**	**5,521,444**	**4,027,843**
TPP KOSTOLAC B 2					41.001	41.001	41.001				3,498	1,931	2,790
TOTAL											3,254	3,055	925
											6,752	**4,986**	**3,715**

APPENDIX A - LIST OF SERBIAN POWER PLANTS
(Continuation)

POWER PLANTS	POWER (MW); *(MWt) ¹(t/h)	COMMISSIONING YEAR	PLANT IN OPERATION YES / NO	FUEL	NET CALORIFIC VALUE (MWh/t) or (GJ/t)			ELECTRICITY PRODUCTION (GWh/y) (**GWht/y)			FUEL CONSUMPTION (t/y); (m³/y)		
					2008	2009	2010	Year 2008	Year 2009	Year 2010	Year 2008	Year 2009	Year 2010
TPP-HP NOVI SAD A 1	135; *128; ¹320	1981	YES	Heavy fuel oil	41.188	41.250	41.25	82.810	62.059	129.715			
TPP-HP NOVI SAD A 2	110; *240	1984	YES		41.128	41.250	41.25	179.344	67.741	79.594			5077
TOTAL	**245; *368; ¹320**							**262.154**	**129.800**	**209.309**	**20,062**	**20,040**	5152 **10,229**
TPP-HP NOVI SAD A 1	Electricity capacity; *Heat capacity; ¹Steam generation			Gas	33.338	33.338	33.338						
TPP-HP NOVI SAD A 2					33.338	33.338	33.338						38,370,000
TOTAL								****187.560**	****204.095**	****206.092**	**77,364,228**	**33,560,000**	34,918,000 **73,288,000**
TPP-HP ZRENJANIN A 1	110; *140; ¹310	1989	YES	Heavy fuel oil	39.500	41.100							0
TPP-HP ZRENJANIN A2	¹220		YES				0						
TOTAL	**110; *140; ¹530**				39.500	41.100	0						0
TPP-HP ZRENJANIN A 1	Electricity capacity; *Heat capacity; ¹Steam generation			Gas				**101.259**	**8.084**	**12.061**	**12,900**	**5,269**	**0**
TPP-HP ZRENJANIN A2					33.338	33.338	33,338						6,764,000
TOTAL					33.338	33.338	33,338						9,873,000
TPP-HP SREMSKA MITROVICA A 1	*45; 172	1963	YES	Heavy fuel oil	40.760	40.670	41.250	****98.677**	****103.694**	****79.896**	**45,581,000**	**13,344,153**	**16,637,000**
TPP-HP SREMSKA MITROVICA A 3	32; *160; ¹200	1979	YES		40.760	40.670	41.250						19
TOTAL A3 and Auxiliary boiler room (A1)	**32; *205; ¹272**							**3.537**	**0.743**	**0.947**	**1,789**	**1,283**	0 **19**
TPP-HP SREMSKA MITROVICA A 1	Electricity capacity; *Heat capacity; ¹Steam generation			Gas	34.126	34.130	33.338						
TPP-HP SREMSKA MITROVICA A 3					34.126	34.130	33.338						948,000
TOTAL A 3 and Auxiliary boiler room (A1)													4,063,000
TOPLANA VREOCI	2x*60	1981	YES	Coal	9.436	9.858	8.635	****33.609**	****30.578**	****32.248**	**8,659,000**	**3,363,000**	**5,011,000**
TOPLANA VREOCI	*120			Heavy fuel oil	40.000	40.000	40.000	****410.394**	****404.447**	****407.963**	**198,990**	**189,621**	**207,767**
TOTAL	*Heat capacity										**164**	**150**	**179**
TOTAL TPP and TPP-HP EPS	**4,667.5 *833 ¹1122**							**25,027.950 **730.240**	**25,019.227 **742.813**	**23,384.417 **726.199**			

APPENDIX B
SERBIAN CARBON EMISSION FACTOR CALCULATION

Name	OK	Simple OM	Average OM	BM	MWe installed	Commissioning Year	Fuel	Emission factor of fuel kgCO2/TJ	Electricity Production GWh year 2008	year 2009	year 2010	Fuel year 2008	year 2009	year 2010	Fuel Consumption TJ year 2008	year 2009	year 2010	Fuel Net Calorific Value year 2008	year 2009	year 2010	Emission Factor of power unit year 2008	year 2009	year 2010
TPP NIKOLA TESLA A 1	1	1	1		210,00	1970	Coal	101.000,00	1.291,1	1.116,4	1.168,9	15.040,6	12.961,1	13.236,1	1.872.118	1.636.096	1.777.646	8,034	7,922	7,445	1.176,58	1.170,49	1.143,66
TPP NIKOLA TESLA A 2	1	1	1		210,00	1970	Coal	101.000,00	1.175,3	1.262,9	1.058,8	13.683,7	14.825,2	11.964,6	1.703.228	1.846.153	1.609.747	8,034	7,922	7,445	1.175,92	1.169,65	1.143,11
TPP NIKOLA TESLA A 3	1	1	1		306,00	1976	Coal	101.000,00	1.968,0	1.825,9	1.646,3	22.846,6	21.060,3	18.832,6	2.844.115	2.660.987	2.502.703	8,034	7,922	7,445	1.174,46	1.166,06	1.143,11
TPP NIKOLA TESLA A 4	1	1	1		308,50	1978	Coal	101.000,00	2.222,1	2.051,1	1.936,9	26.827,9	23.702,7	21.923,9	3.214.820	2.992.013	2.944.782	8,034	7,922	7,445	1.173,94	1.167,17	1.142,05
TPP NIKOLA TESLA A 5	1	1	1		308,50	1979	Coal	101.000,00	2.023,3	1.945,3	1.906,9	23.525,8	22.494,6	21.375,6	2.926.026	2.839.630	2.697.997	8,034	7,922	7,445	1.174,27	1.167,93	1.142,78
TPP NIKOLA TESLA A 6	1	1	1		308,50	1979	Coal	101.000,00	1.003,6	1.972,1	860,9	11.696,6	22.812,0	9.831,8	1.456.257	2.879.671	1.320.690	8,034	7,922	7,445	1.177,42	1.169,30	1.153,46
Total					1.650,5				8.685,4	10.175,7	8.580,6	112.620,1	117.676,2	97.164,6	14.016.562	14.854.388	13.853.067				1.178,43	1.168,27	1.144,89
TPP NIKOLA TESLA A 1	1	1	1		210,00	1970	Heavy fuel oil	77.400,00				148,7	143,4	143,8	3.814	3.676	3.687	39,000	39,000	39,000	8,92	8,92	9,52
TPP NIKOLA TESLA A 2	1	1	1		210,00	1970	Heavy fuel oil	77.400,00				61,7	96,3	121,7	2.094	2.469	3.120	39,000	39,000	39,000	5,38	5,90	8,69
TPP NIKOLA TESLA A 3	1	1	1		305,00	1976	Heavy fuel oil	77.400,00				142,7	111,1	126,3	3.659	2.848	3.290	39,000	39,000	39,000	5,62	4,71	8,03
TPP NIKOLA TESLA A 4	1	1	1		308,50	1978	Heavy fuel oil	77.400,00				349,2	231,0	211,9	8.853	5.924	5.434	39,000	39,000	39,000	12,16	8,72	8,45
TPP NIKOLA TESLA A 5	1	1	1		308,50	1979	Heavy fuel oil	77.400,00				197,6	222,2	225,4	5.065	5.696	6.780	39,000	39,000	39,000	7,66	8,64	9,15
TPP NIKOLA TESLA A 6	1	1	1		308,50	1979	Heavy fuel oil	77.400,00				166,0	118,8	251,7	4.257	3.039	6.453	39,000	39,000	39,000	12,80	4,56	22,83
Total					1.650,5							1.065,8	922,8	1.082,8	27.842	23.654	27.764				8,74	7,12	10,79
TPP NIKOLA TESLA B 1	1	1	1	1	620,00	1983	Coal	101.000,00	4.509,5	4.116,3	3.641,1	48.854,2	45.511,4	39.235,2	6.262.556	6.898.825	5.281.383	7,801	7,766	7,429	1.094,20	1.116,69	1.088,54
TPP NIKOLA TESLA B 2	1	1	1		620,00	1985	Coal	101.000,00	3.867,7	3.323,1	4.472,2	41.915,9	36.730,4	48.141,5	5.373.146	4.728.422	6.480.212	7,801	7,766	7,429	1.094,58	1.116,36	1.087,23
Total					1.240,0				8.377,2	7.439,4	8.113,3	90.770,1	82.241,7	87.376,7	11.635,702	11.627.247	11.761.595				1.094,39	1.116,53	1.087,78
TPP NIKOLA TESLA B 1	1	1	1		620,00	1983	Heavy fuel oil	77.400,00				180,1	187,1	275,3	4.108	4.798	7.058	39,000	39,000	39,000	2,75	3,52	5,85
TPP NIKOLA TESLA B 2	1	1	1		620,00	1985	Heavy fuel oil	77.400,00				207,9	160,0	369,4	5.330	4.847	9.471	39,000	39,000	39,000	4,16	4,40	8,39
Total					1.240,0							388,0	347,1	644,6	9.438,0	9.645,0	16.529,0				3,45	3,96	6,12
TPP KOLUBARA A 1	1	1	1		36,00	1956	Coal	101.000,00	176,9	182,3	183,4	7.771	8.930	2.652,6	1.008.763	1.334.997	397.760	7,719	6,689	6,694	1.660	1.614	1.466,32
TPP KOLUBARA A 2	1	1	1		35,00	1957	Coal	101.000,00	144,4	56,2	128,3			2.028,9			306.280	7,719	6,689	6,646			1.597,18
TPP KOLUBARA A 3	1	1	1		35,00	1961	Coal	101.000,00	0,0	213,4	159,1			1.326,7			198.790	7,719	6,689	6,664			843,49
TPP KOLUBARA A 4	1	1	1		55,00	1961	Coal	101.000,00	148,6	107,0	0,0			1.580,5			232.530	7,719	6,689	6,710			-
TPP KOLUBARA A 5	1	1	1		110,00	1979	Coal	101.000,00	618,2	270,0	610,0	8.201,3	3.542,9	7.693,1	1.100.769	528.687	1.182.450	7,505	6,686	6,618	1.349,71	1.325,32	1.273,77
Total					270,00				1.081,1	828,9	1.080,9	16.032,5	12.472,7	15.273,8	2.107.532	1.863.684	2.299.810				1.404,72	1.409,53	1.376,05
TPP KOLUBARA A 1	1	1	1		36,00	1956	Oil	74.100,00				61	78	41,9	1.449	1.855	992	42,226	42,267	42,2058	10	10	16,92
TPP KOLUBARA A 2	1	1	1		35,00	1957	Oil	74.100,00						25,2			598	42,226	42,267	42,2058			14,58
TPP KOLUBARA A 3	1	1	1		35,00	1961	Oil	74.100,00						26,6			631	42,226	42,267	42,2058			12,40
TPP KOLUBARA A 4	1	1	1		55,00	1961	Oil	74.100,00						30,9			731	42,226	42,267	42,2058			-
TPP KOLUBARA A 5	1	1	1		110,00	1979	Oil	74.100,00				34,4	38,4	58,7	815	883	1.320	42,226	42,222	42,2058	4,13	10,00	4,77
Total					270,00							95,4	116,4	183,3	2.264,0	2.738,0	4.272,0				4,88	19,28	12,67
TPP MORAVA A 1	1	1	1		110,00	1969	Coal	101.000,00	835,6	539,1	576,3	8.803,9	6.023,2	6.562,7	602.822	697.941	776.665	8,475	8,630	8,426	1.080,84	1.126,45	1.146,18
TPP MORAVA A 1	1	1	1				Heavy fuel oil	77.400,00				59,0	58,5	75,1	1.514	1.387	1.831	39,000	40,729	40,687	7,19	8,11	10,05
TPP MORAVA A 1	1	1	1				Oil	74.100,00				8,5	11,4	10,2	154	259	248	42,226	42,474	40,997	0,76	1,57	1,30
Total									835,6	539,1	576,3	8.871,4	6.093,1	6.647,9	604.490,0	699.587,0	778.744,0				362,93	379,38	388,84
TPP KOSTOLAC A 1	1	1	1			1967	Coal	101.000,00	681,7	601,1	574,7	7.429,7	7.852,6	7.411,3	907.496	957.421	916.672	8,187	8,202	8,066	1.360,16	1.319,46	1.302,49
TPP KOSTOLAC A 2	1	1	1			1980	Coal	101.000,00	1.313,4	1.309,5	1.313,2	16.058,1	15.329,2	15.768,6	1.970.068	1.869.872	1.949.629	8,150	8,198	8,088	1.234,70	1.182,32	1.212,78
Total									1.995,1	1.910,6	1.887,9	23.485,7	23.181,8	23.179,8	2.877.564,0	2.827.293,0	2.866.301,0				1.297,43	1.238,88	1.257,64
TPP KOSTOLAC A 1	1	1	1		100,00		Oil	74.100,00				48,3	38,3	29,7	1.150	912	707	42,000	42,000	42,000	8,49	4,72	3,83
TPP KOSTOLAC A 2	1	1	1		210,00		Oil	74.100,00				48,4	37,9	32,3	1.153	902	769	42,000	42,000	42,000	2,73	2,14	1,82
Total					310,00							96,7	76,2	62,0	2.303,0	1.814,0	1.476,0				4,61	3,43	2,82
TPP KOSTOLAC B 1	1	1	1	1	350,00	1987	Coal	101.000,00	1.422,5	1.973,8	2.012,2	15.549,5	22.235,8	22.325,2	1.940.775	2.731.316	2.768.585	8,012	8,141	8,093	1.104,04	1.137,81	1.120,59
TPP KOSTOLAC B 2	1	1	1	1	330,00	1991	Coal	101.000,00	1.589,1	2.013,1	908,8	17.478,2	22.711,6	10.259,4	2.090.883	2.790.128	1.269.260	8,325	8,140	8,063	1.110,88	1.139,47	1.140,44
Total					680,00				3.011,6	3.986,9	2.921,0	33.027,7	44.947,4	32.584,6	4.031.658,0	5.521.444,0	4.037.845,0				1.107,46	1.138,64	1.130,91
TPP KOSTOLAC B 1	1	1	1				Heavy fuel oil	77.400,00				143,4	79,2	114,4	3.498	1.931	2.790	41,001	41,001	41,001	7,80	3,10	4,40
TPP KOSTOLAC B 2	1	1	1				Heavy fuel oil	77.400,00				133,4	125,3	37,9	3.264	3.055	825	41,001	41,001	41,001	6,80	4,82	3,23
Total												277	204	152	6.762	4.986	3.615				7,15	3,96	3,82
TPP-HP NOVI SAD A 1	1	1	1		135,00	1981	Heavy fuel oil	77.400,00	82,810	62,059	129,716			209,4			8.077	41,188	41,250	41,250	-		
TPP-HP NOVI SAD A 2	1	1	1		110,00	1984	Heavy fuel oil	77.400,00	179,344	67,741	78,594			212,5			5.152	41,128	41,250	41,250			
Total					245,00				262,154	129,800	208,309	625,7	625,7	421,9	38.062	28.646	10.229	41,158	41,250	41,250	243,79	482,93	156,83
TPP-HP NOVI SAD A 1	1	1	1				Gas	56.100,00									30.370.000	33,338	33,338	33,338			
TPP-HP NOVI SAD A 2	1	1	1				Gas	56.100,00									34.918.000	33,338	33,338	33,338			
Total									187,56 (*)	204,065 (*)	206,842 (*)				77.384.229	33.668.000	73.298.000						
TPP-HP ZRENJANIN A 1	1	1	1	1	110,00	1989	Heavy fuel oil	77.400,00									0	39,500	41,100	0,000			
TPP-HP ZRENJANIN A 2	1	1	1	1			Heavy fuel oil	77.400,00									0	39,500	41,100	0,000			
Total									101,259	6,664	12,661	569,8	296,6	0,0	12.860	5.280	0				388,49	2.873,41	-
TPP-HP ZRENJANIN A 1	1	1	1				Gas	56.100,00									6.764.000	33,338	33,338	33,338			
TPP-HP ZRENJANIN A 2	1	1	1				Gas	56.100,00															
Total																							
TPP-HP SREMSKA MITROVICA A 1	1	1	1			1963	Heavy fuel oil	77.400,00	98,677 (*)	183,684 (*)	79,890 (*)						9.873.000	33,338	33,338	33,338			
TPP-HP SREMSKA MITROVICA A 3	1	1	1		32,00	1979	Heavy fuel oil	77.400,00							46.361.886	13.344.153	16.637.000						
Total A3 and auxiliary boiler room (A1																	19	40,780	40,670	41,250			
TPP-HP SREMSKA MITROVICA A 1	1	1	1				Gas	56.100,00	3,537	6,743	8,547	72.919,0	82.179,0	783,8	1.769	1.293	0	40,780	40,670	41,250			
TPP-HP SREMSKA MITROVICA A 3	1	1	1				Gas	56.100,00									19				1.889.896,98	5.435.666,66	64.837,29
Total A3 and auxiliary boiler room (A1																	948.000	34,126	34,130	33,338			
TOPLANA VREOCI	1	1	1						33,699 (*)	30,579 (*)	32,348 (*)						4.083.000	34,126	34,130	33,338			
TOPLANA VREOCI	1	1	1			1981	Coal	101.600,00	410,394 (*)	404,447 (*)	407,563 (*)				5.669.000	3.363.000	5.011.000						
Total							Heavy fuel oil	77.400,00							192.396	189.621	207.787	9,436	8,658	8,635			
															164	150	179	40,000	40,000	40,000			
TOTAL TPP and TPP-HP EPS															189.164	189.771	207.946						
					4.537,50				26.028,186	23.818,227	23.384,217												
HPP DJERDAP I - A1	1	-	1	-	1.058,0	1970-1972	water		870,0	928,8	1.319,0												
HPP DJERDAP I - A2	1	-	1	-			water		699,1	965,0	1.325,5												
HPP DJERDAP I - A3	1	-	1	-			water		917,2	1.052,4	1.232,4												
HPP DJERDAP I - A4	1	-	1	-			water		969,6	1.053,0	1.280,6												
HPP DJERDAP I - A5	1	-	1	-			water		846,5	1.059,2	1.250,5												
HPP DJERDAP I - A6	1	-	1	-			water		885,2	981,6	0,0												
HPP DJERDAP I - Total									5.387,6	5.760,2	6.397,8												
HPP DJERDAP II - A1	1	-	1	1	270,0	1985-87,98,2001	water		177,7	134,4	166,0												
HPP DJERDAP II - A2	1	-	1	1			water		165,5	113,1	161,4												
HPP DJERDAP II - A3	1	-	1	1			water		173,6	182,1	116,1												
HPP DJERDAP II - A4	1	-	1	1			water		171,8	171,2	116,7												
HPP DJERDAP II - A5	1	-	1	1			water		178,4	173,1	167,0												
HPP DJERDAP II - A6	1	-	1	1			water		11,9	172,5	164,1												
HPP DJERDAP II - A7	1	-	1	1			water		94,7	36,0	163,8												
HPP DJERDAP II - A8	1	-	1	1			water		171,5	136,3	167,1												
HPP DJERDAP II - A9	1	-	1	1			water		186,1	181,7	167,4												
HPP DJERDAP II - A10	1	-	1	1			water		178,8	189,3	166,6												
HPP DJERDAP II - Total									1.510,8	1.489,7	1.556,2												
HPP PIROT - A1	1	-	1	1	80,0	1990	water		59,9	47,0	109,4												
HPP PIROT - A2	1	-	1	1			water		55,1	44,2	102,4												
HPP PIROT - Total									115,0	91,2	211,8												
HPP VLASINA VRLA 1 - (A1-A4)	1	-	1	-	129,0	1955	water		54,9	111,0	153,6												
HPP VLASINA VRLA 2 - (A1-A2)	1	-	1	-		1954	water		30,0	60,3	84,9												
HPP VLASINA VRLA 3 - (A1-A2)	1	-	1	-		1975	water		45,0	84,6	118,1												
HPP VLASINA VRLA 4 - (A1-A2)	1	-	1	-		1958	water		38,5	74,7	103,0												
HPP VLASINA - Total									168,4	330,6	459,6												
HPP DJERDAP KLADOVO - Total					1.537,8				7.167,2	7.671,7	8.622,8												
HPP BAJINA BASTA - A1	1	-	1	-	364,0	1966-1968	water		222,7	224,3	159,2												
HPP BAJINA BASTA - A2	1	-	1	-			water		463,7	543,1	460,6												
HPP BAJINA BASTA - A3	1	-	1	-			water		318,6	432,0	337,5												
HPP BAJINA BASTA - A4	1	-	1	-			water		269,3	442,1	519,7												
HPP BAJINA BASTA - Tota									1.274,3	1.641,5	1.477,0												
PUMPED-STORAGE PP BAJINA BASTA - A1	1	-	1	-	614,0	1982	water		270,0	298,9	329,8												
PUMPED-STORAGE PP BAJINA BASTA - A2	1	-	1	-			water		273,6	303,8	349,8												
PUMPED STORAGE PP BAJINA BASTA - Tota									543,6	602,7	679,6												

APPENDIX B - SERBIAN CARBON EMISSION FACTOR CALCULATION

Name	OM	Simple OM	Average OM	BM	MWe installed	Commissioning Year	Fuel	Emission factor of fuel (kgCO2/TJ)	Electricity Production GWh/y year 2008	year 2009	year 2010	Qty fuel year 2008	year 2009	year 2010	Fuel Consumption (t/y) year 2008	year 2009	year 2010	Fuel Net Calorific Value year 2008	year 2009	year 2010	Emission Factor of power unit year 2008	year 2009	year 2010
HPP ZVORNIK - A1	1	-	1	-	96,0	1955-1958	water		106,7	123,6	137,5												
HPP ZVORNIK - A2	1	-	1	-			water		114,6	129,2	147,2												
HPP ZVORNIK - A3	1	-	1	-			water		89,1	126,3	145,8												
HPP ZVORNIK - A4	1	-	1	-			water		94,9	130,7	144,4												
HPP ZVORNIK - Total									405,3	509,8	574,9												
HPP ELEKTROMORAVA MEDJUVRSJE - A1	1	-	1	-	15,0	1954-1957	water		10,3	6,0	10,6												
HPP ELEKTROMORAVA MEDJUVRSJE - A2	1	-	1	-		1954-1958	water		18,5	15,6	24,2												
HPP ELEKTROMORAVA OVCAR BANJA - A1	1	-	1	-		1954-1959	water		5,6	7,0	12,6												
HPP ELEKTROMORAVA OVCAR BANJA - A2	1	-	1	-		1954-1960	water		13,2	18,2	23,7												
HPP ELEKTROMORAVA - Total									47,6	46,1	71,5												
HPP LIMSKE POTPEC - A1	1	-	1	-	51,0	1967-1970	water		47,5	61,3	79,8												
HPP LIMSKE POTPEC - A2	1	-	1	-			water		44,9	67,4	85,4												
HPP LIMSKE POTPEC - A3	1	-	1	-			water		56,6	70,1	81,8												
HPP LIMSKE POTPEC - Total									149,0	198,8	246,8												
HPP LIMSKE BISTRICA - A1	1	-	1	-	102,0	1960	water		151,6	147,8	212,3												
HPP LIMSKE BISTRICA - A2	1	-	1	-			water		140,4	119,4	202,1												
HPP LIMSKE BISTRICA - Total									292,0	267,2	414,4												
HPP LIMSKE KOKIN BROD - A1	1	-	1	-	22,0	1962-1967	water		22,6	22,6	36,2												
HPP LIMSKE KOKIN BROD - A2	1	-	1	-			water		25,7	23,1	38,7												
HPP LIMSKE KOKIN BROD - Total									48,3	45,7	74,9												
HPP LIMSKE UVAC - A1	1	-	1	-	36,00	1979	water		45,5	58,6	66,3												
HPP DRINSKO - LIMSKE - Total					1.298,0				2.776,7	3.314,6	3.740,3												
HPP EPS					2.835,00			-	9.965,90	10.986,50	12.363,10	-	-	-									
TOTAL TPP/TPP HF EPS + HPP EPS									34.994,05	36.005,73	35.747,32												
IMPORTATION (**)	1	1	1	-			as water	-	11.230,00	11.230,00	121,00	-	-	-									
GRAND TOTAL (TPP+HPP+importation)									46.224,05	47.235,73	35.868,32												
TOTAL ENERGY OM									26.028,15	25.019,23	23.384,22	24.477,20	69%										
TOTAL ENERGY BM									8.651,56	8.808,98	8.173,08	8.801,20	25%										
TOTAL ENERGY PER YEAR									34.994,05	36.005,73	35.747,32	35.582,36	100%										

Notes:
(*) Thermal Energy production, GWh/y. These values were not considered in the CEF calculation.
(**) Importation data from Index Mundi, Serbia Electricity imports, website: http://www.indexmundi.com/serbia/electricity_imports.html.

MW installed

7.372,50 total production (TPP + HPP)
3.686,25 50% of total production
2.835,00 HPP production is < 50% of total production.Simple OM method is used

Electricity production (GWh/y)

Year 2008	Year 2009	Year 2010	
34.994,05	36.005,73	35.747,32	total production (TPP + HPP)
17.497,03	18.002,86	17.873,66	50% of total production
9.965,90	10.986,50	12.363,10	HPP production is < 50% of total production.Simple OM method is used

SIMPLE OPERATING MARGIN (OM)

Year 2008

940 tCO_2/GWh

Year 2009

805 tCO_2/GWh

Year 2010

1.119 tCO_2/GWh

Weighted Average (on electricity production)

954,86	tCO_2/GWh
0,955	tCO_2/MWh

BUILD OPERATING MARGIN (BM)

Year 2008

869 tCO_2/GWh

Year 2009

932 tCO_2/GWh

Year 2010

894 tCO_2/GWh

Weighted Average (on electricity production)

936,20	tCO_2/GWh
0,936	tCO_2/MWh

CEF OF SERBIA

0.5 * OM + 0.5 * BM

945,03	tCO_2/GWh
0,945	tCO_2/MWh

Serbian Ministry of Environment, Mining and Spatial Planning,
Technical Assistance for the Revision of PDDs
Calculation of the Carbon Emission Factor for the Serbian Power Grid