Quantifying CO2 abatement costs in Serbian power sector in 2014.

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1 DISCLAIMER

This paper has been produced within the framework of the project agreed between European Climate Foundation and RES Foundation (ECF reference, G-1505-55348, RES reference ECF01/15).

The paper presented herewith (and accompanied calculations) is **solely dedicated to present the results of the analysis to ECF** and cannot be used for other purposes.

RES Foundation will use the results of the analysis in line with the communication strategy developed for this project and will communicate the results of the analysis in the form that is seen as most adequate to each of the target groups. Estimations and calculations presented in this paper are made using only publicly available data. No additional research has been performed to obtain new data. Data have been analyzed and used based on the methodology presented in the paper. All data have been obtained from the web.

2 INTRODUCTION

The purpose of this paper is to calculate the unit costs of abated CO_2 emissions from Serbian power sector in 2014.

54 different unit costs have been calculated as results of different assumptions on the values of certain parameters. 27 unit costs have been calculated based on the actual 2014. set of parameters, while other 27 have been calculated assuming the values that parameters would have if 2014. hydro power production has been equal to average 2008.-2013. production.

Under these assumptions calculated unit costs fall in the range between -76 (when avoided externalities are also taken into consideration) and 9 Euros, per ton of CO_2 abated. For example, price of EU emission allowances for Germany achieved during the 30.10.2015. auction has reached 8.59 Euros per allowance.

The calculation in this analyses has not taken into consideration any damage to the assets of the utilities. Focus was to calculate financial and material effects of the consequences, not to calculate costs of the damage caused by floods and associated events that have caused reduced electricity production and reduced CO2 emissions.

Total abatement costs have been calculated based on the differences between realized parameters in power sector in 2014. (and adjusted realized parameters) and parameters from counterfactual scenario. This counterfactual scenario is based on "average year". "Average year" parameters have been calculated as average values of selected set of data in the period form 2008. till 2013. Different sources of data have been consulted for creation of both "average year" and counterfactual scenario. These sources are: Statistical office of Serbia (RZS), Transmission system operator (EMS)., Electric power utility of Serbia (EPS), and Regulatory Energy Agency (AERS).

It is interesting to note that reduction in coal consumption (in terms of quantities) in both analyzed utilities was larger than reduction in energy produced which may indicate either improved efficiency or better coal quality. Anyhow productivity was increased in both utilities.

3 SUMMARY OF RESULTS

Calculated unit costs fall in the range between -76 (when avoided externalities are also taken into consideration) and 9 Euros, per ton of CO_2 abated.

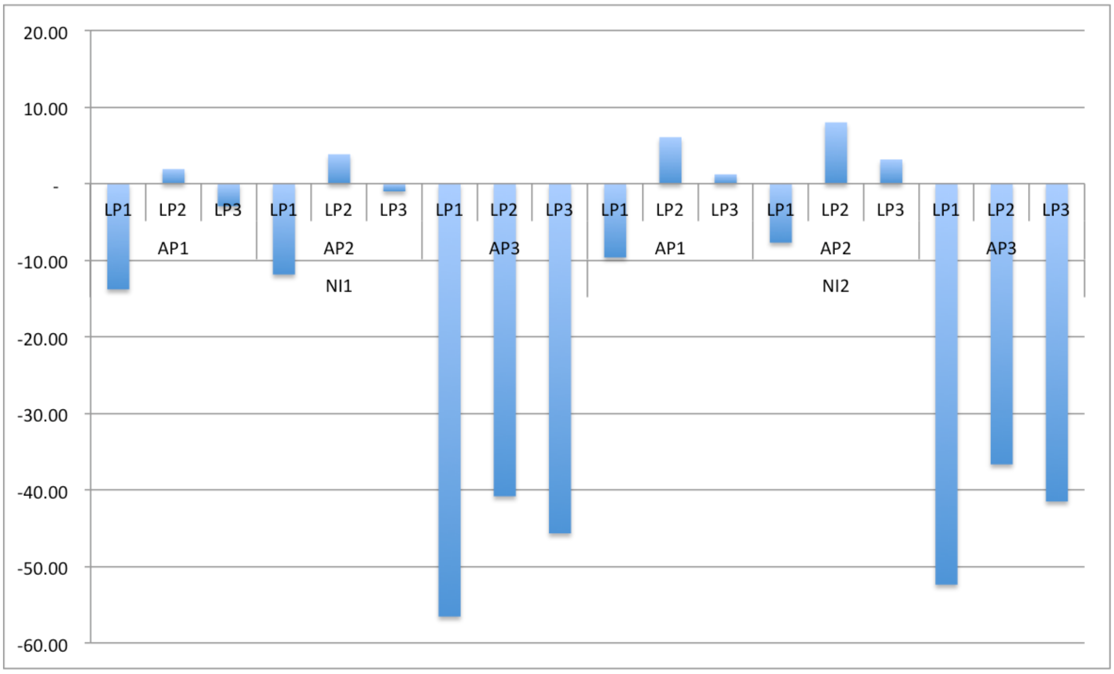

Figure 1 Per unit abatement costs in EUR per TCO_2 for average non hydro -adjusted scenarios

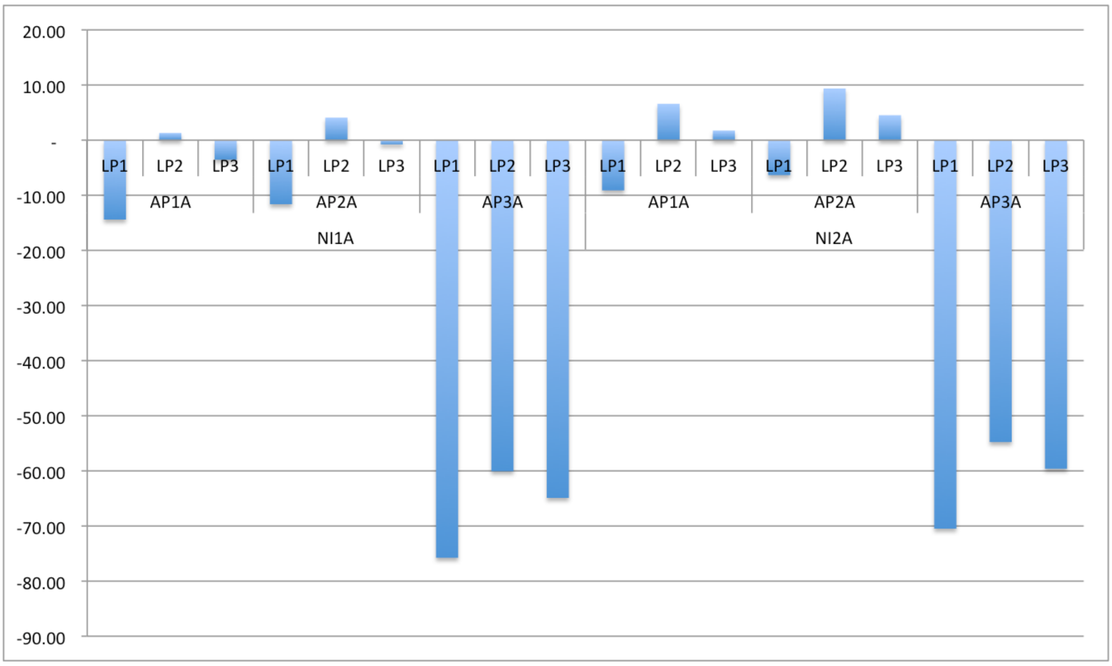

Figure 2 Per unit abatement costs in EUR per TCO_2 for hydro -adjusted scenarios

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If we exclude external costs from the calculations unit abatement costs fall in the range from -14.40 to 9.38 Euros, per ton of CO_2 abated.

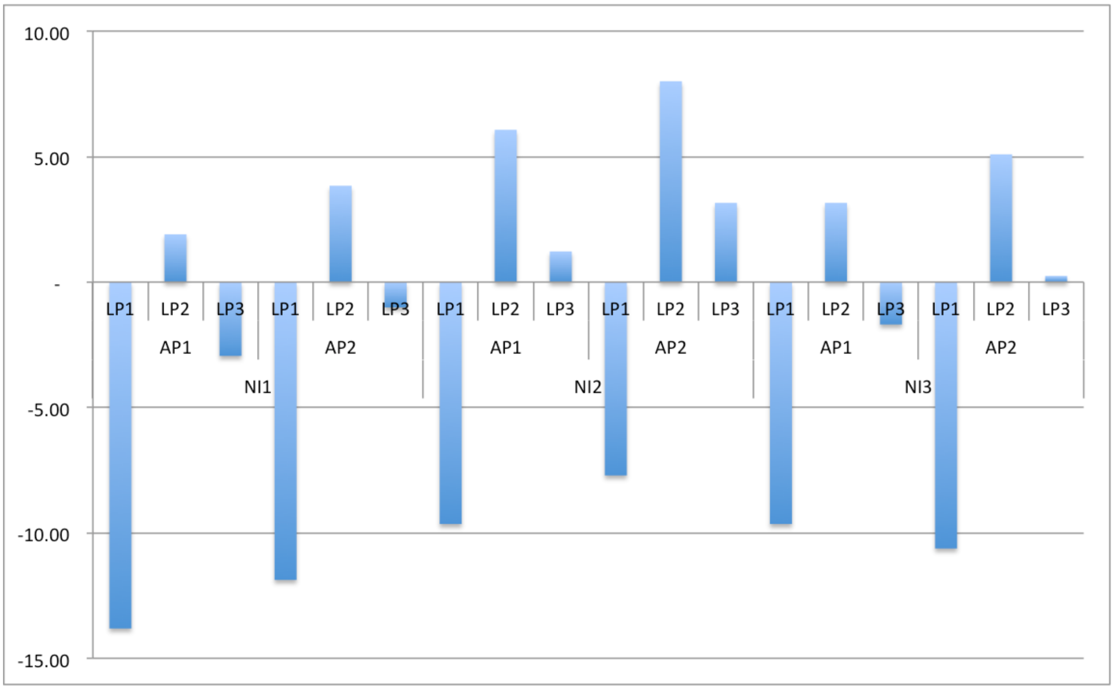

Figure 3 Per unit abatement costs in EUR per TCO₂ for non hydro -adjusted scenarios without external costs (AP3 cost option excluded)

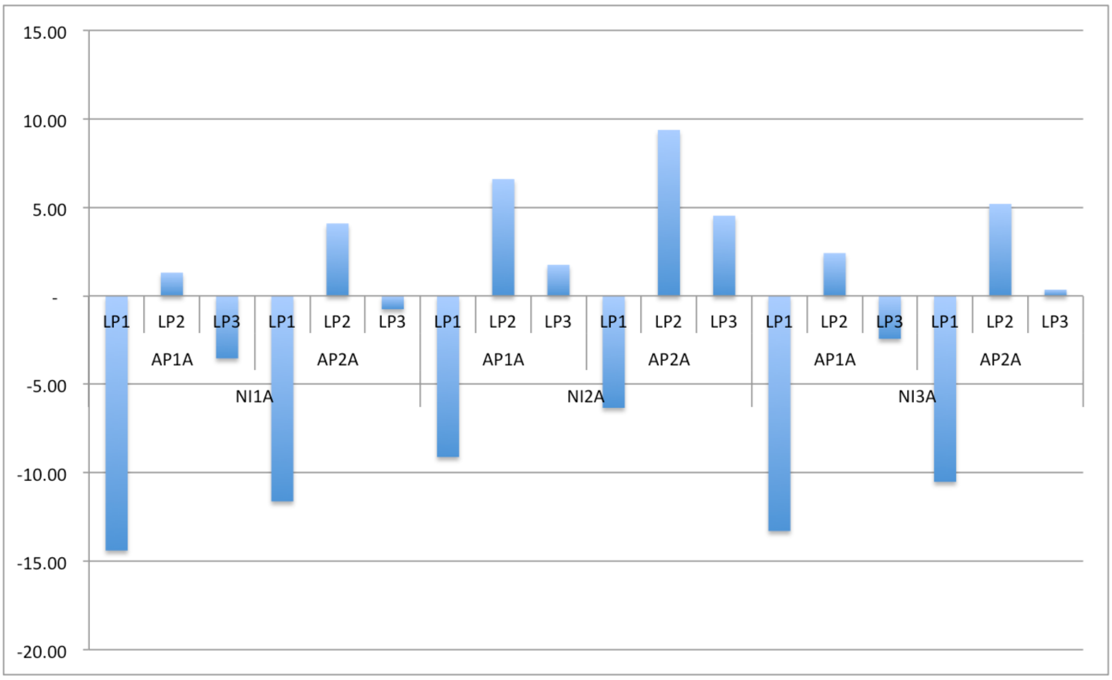

Figure 4 Per unit abatement costs in EUR per TCO₂ for hydro -adjusted scenarios costs without external costs (AP3 cost option excluded)

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Much lower costs have been computed when lost profits (in Euros) have been calculated as a difference between 2014. profits of involved utilities and average profits in years 2008.-2013. (LP1 scenario). Since 2014. profits were actually much higher than average in observed period this calculation results in conclusion that this particular pattern of reduced production was actually beneficial for profit making of the utilities. Further analysis in this direction may perhaps discover possible modalities for permanent productivity increase in both utilities.

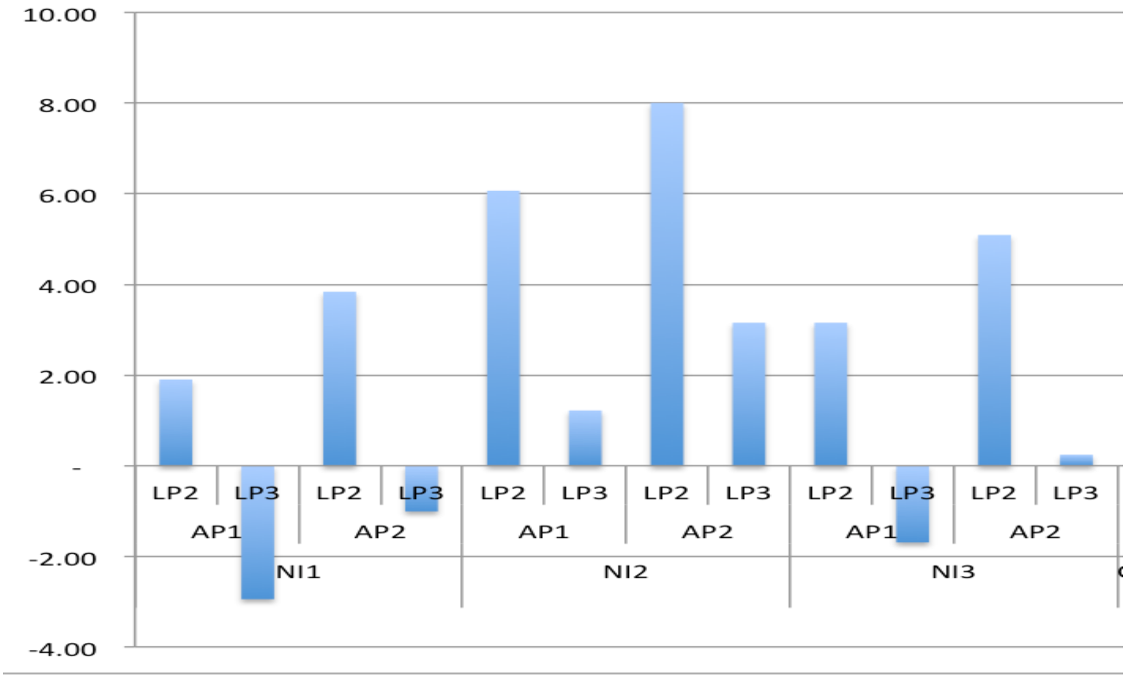

Figure 5 Per unit abatement costs in EUR per TCO_2 for non hydro -adjusted scenarios without external costs (AP3 cost option excluded and LP1 scenario excluded)

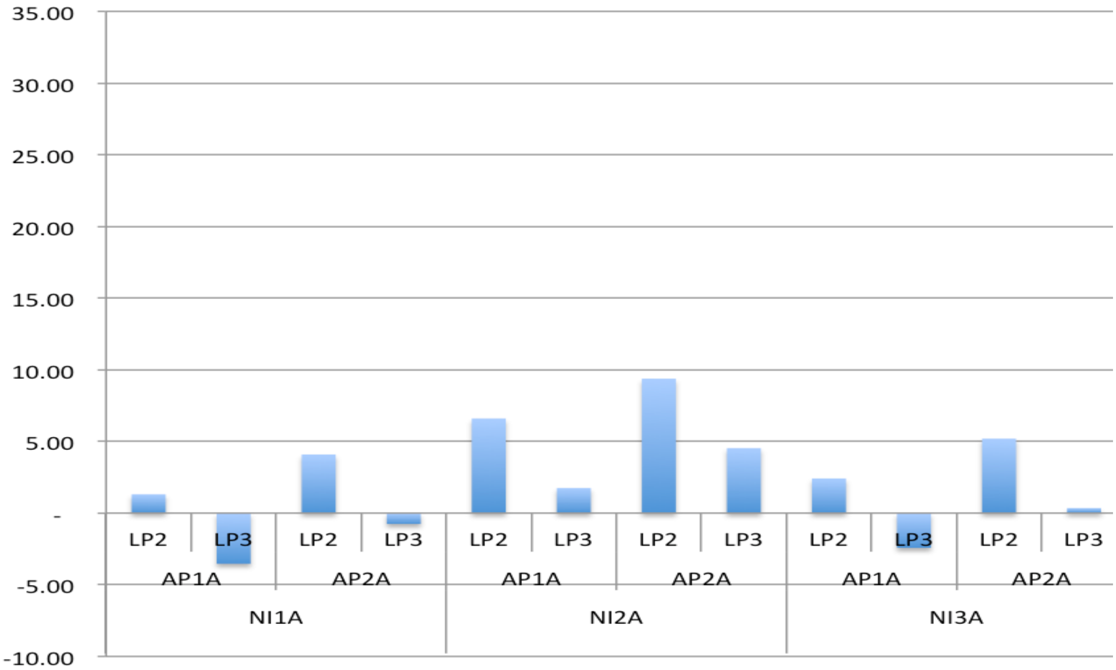

Figure 6 Per unit abatement costs in EUR per TCO_2 for hydro -adjusted scenarios without external costs (AP3 cost option excluded and LP1 scenario excluded)

Finally, in this summary we also present results that do not include lost profits of the utilities (LP3 scenario only). This scenario reflect the position of the electricity supplier who buys and sells electricity not taking into account its origin and ownership structure of its vendors.

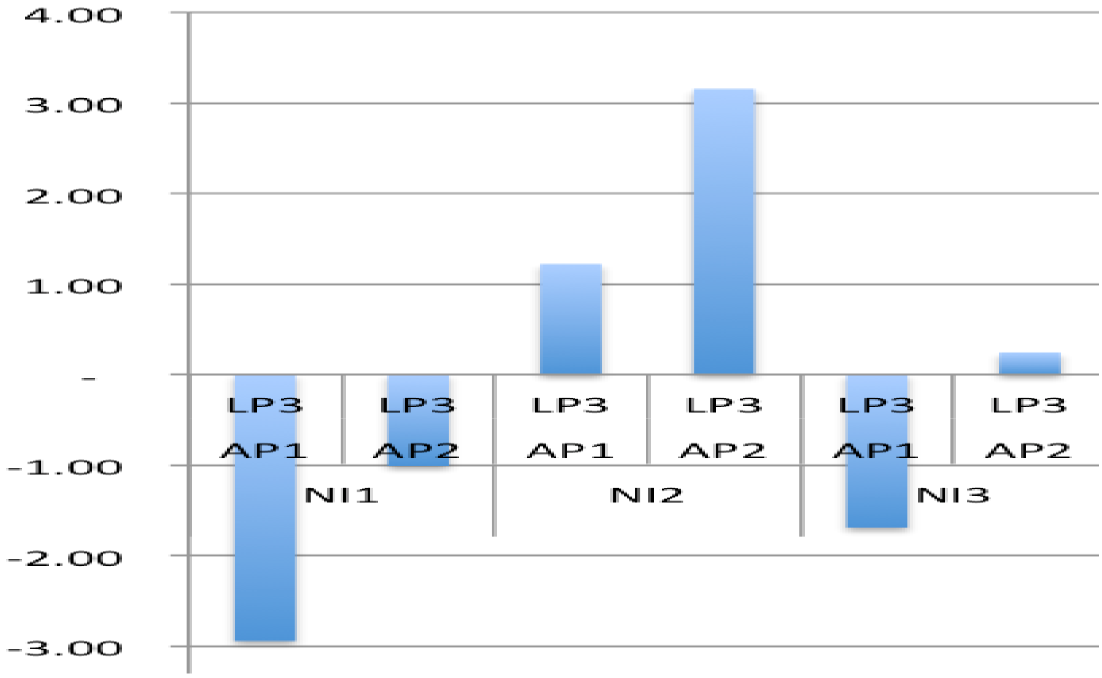

Figure 7 Per unit abatement costs in EUR per TCO_2 for non hydro -adjusted scenarios without external costs (AP3 cost option excluded) and without lost profit.

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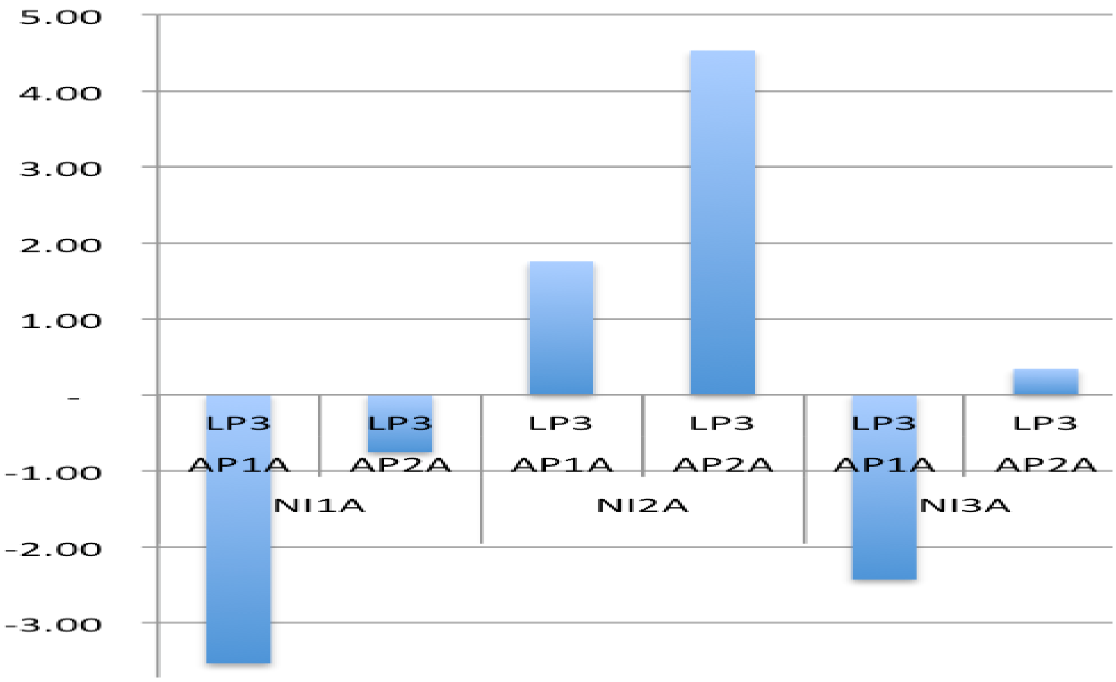

Figure 8 Per unit abatement costs in EUR per TCO_2 for hydro -adjusted scenarios without external costs (AP3 cost option excluded) and without lost profit.

In the last two set of assumptions, per unit abatement costs range from -4 to 4 Euros per ton of CO_2 abated.

Net import costs most significantly affected the unit cost of abatement.

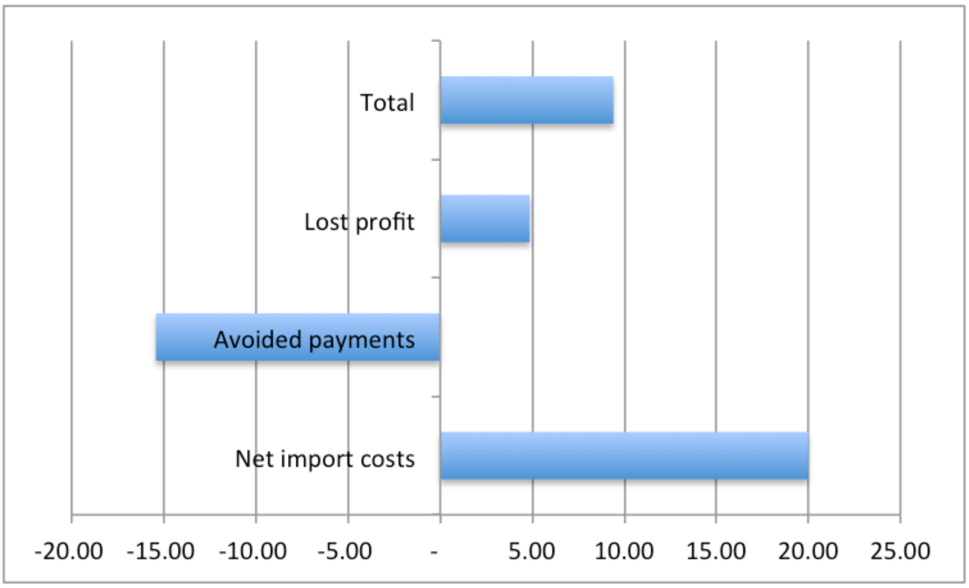

Figure 9 Structure of per unit abatement costs for highest calculated cost

4 BASIC PLANT DATA- 2014

Table 1 EPS net output plant capacity (MW). Source: EPS

Power plant	Net output capacity (MW)
TPP Nikola Tesla A	1,502
TPP Nikola Tesla B	1,160
TPP Kolubara	245
TPP Morava	108
TPP Kostolac A	281
TPP Kostolac B	640
THERMAL POWER PLANTS	3,936
CHP Novi Sad	208
CHP Zrenjanin	100
CHP Sremska Mitrovica	45
COMBINED Heat and Power Plants	353
HPP Đerdap 1	1,058
HPP Đerdap 2	270
Vlasinske HPPs	129
HPP Pirot	80
HPP Bajina Bašta	364
PSHPP Bajina Bašta	614
HPP Zvornik	96
HPP Elektromorava	13
HPP Potpec	51
HPP Bistrica and HPP Kokin Brod	124
HPP Uvac	36
HYDRO Power Plants	2,835
EPS POWER PLANTS	7,124

Table 2 2014. electricity production of EPS power plants. Source: EPS

Power plant	Net output capacity (GWh)
TPP Nikola Tesla A	7,851
TPP Nikola Tesla B	7,523
TPP Kolubara	459
TPP Morava	490
TPP Kostolac A	1,834
TPP Kostolac B	2,298
THERMAL POWER PLANTS	20,455
CHP Novi Sad	63
CHP Zrenjanin	0
CHP Sremska Mitrovica	0
COMBINED Heat and Power Plants	63
HPP Đerdap 1	5,910
HPP Đerdap 2	1,613
Vlasinske HPPs	292
HPP Pirot	124
HPP Bajina Bašta	1,613
PSHPP Bajina Bašta	614
HPP Zvornik	489
HPP Elektromorava	79
HPP Potpec	217
HPP Bistrica and HPP Kokin Brod	424
HPP Uvac	70
HYDRO Power Plants	11,445
EPS POWER PLANTS	31,963

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5 DEVELOPMENTS IN 2014.[1]

During the third week of May, exceptionally heavy rains fell on Serbia which were caused by a low-pressure system ('Yvette') that formed over the Adriatic. Record-breaking amounts of rainfall were recorded more than 200 mm of rain fell in western Serbia in a week's time, which is the equivalent of 3 months of rain under normal conditions

The heavy rainfalls led to a rapid and substantial increase of water levels in the main rivers in western, south-western, central and eastern Serbia. In the Sava river basins where most of the rainfall was received, the consequences were two-fold. In the first place, flash floods occurred in the tributaries where water levels rose almost immediately after the onset of the rains and then dropped quickly back to normal levels when the rains stopped. In this regard, the water level at Beli Brod on the tributary river Kolubara rose by 7 meters between 14-16 May but was back to normal levels by 18-19 May. The second consequence was that the level of the river Sava itself rose at a more gradual rate, with an increase of 3.5 meters recorded over the period 14-20 May. In contrast to its tributaries, the water level on the Sava peaked after the rains had stopped and decreased much more slowly after the peak (by some 20-30 centimetres per day). This delay in response time is due to the travelling time of the water through the entire river catchment including the upstream reaches of the Sava.

The heavy rainfall and rising water levels had three immediate and direct effects:

- - High intensity flash floods resulting in the total destruction of houses, bridges and sections of roads (in Krupanj and areas around Sabac);
- - Rising water levels resulting in the widespread flooding of both urban areas (particularly in Obrenovac) and rural areas (around Sabac); and,
- - Increased flow of underground waters leading to widespread landslides (around Krupanj and Bajina Basta).

Overall the floods affected some 1.6 million people living in 38 municipalities /cities mostly located in central and western Serbia. Two cities1 and 17 municipalities2 were severely impacted.

Year 2014 will be remembered in the history of Electric Power Industry of Serbia as one of the most dramatic. Unprecedented natural disasters of catastrophic proportions lined up one after another. First the floods in May flooded Kolubara mines, the operation of thermal power plant Nikola Tesla A was also interrupted, water's destructive power endangered many substations and generation facilities of Electric Power Industry of Serbia. The real cataclysm in July struck production capacities of TPPs-OCMs Kostolac, and in September the rains and river floods caused great damage to Đerdap hydro power plants.

[1] Based on "Serbia floods 2014" and EPS 2014. Annual Report

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Natural disasters had an enormous impact on business operation of EPS in 2014. For only a few days, starting from 14 May, Kolubara mines had been disabled, overburden and coal production stopped and it was questionable with what will we "feed" thermal power plants in Obrenovac. Battles were waged for our thermal power plants: Obrenovac thermal power plants Nikola Tesla, Kostolac and Morava. Inflows rose. Danube was approaching historical inflow from 2006, and on the banks of Drina landslides appeared. The repair of damage started immediately, and in early August coal production started in Veliki Crljeni, where about 47 million cubic meters of water was pumped out with own capacities. Contractor for pumping out water and silt was selected for Tamnava-West Field mine, in which more than 180 million cubic meters of water entered, and on 25 December coal production started there. EPS managed to ensure a stable supply and sufficient quantities of electricity for the citizens and economy of Serbia even in these extraordinary conditions. There were no electricity restrictions. Constant engagement of all EPS employees saved the stability of the electric power system of Serbia. Already at the end of July, an unprecedented storm and hail caused damage to the capacities in Kostolac. In mid-September, foul weather left huge impact on Đerdap hydro power plants as well.

6 ELECTRICITY AND COAL BALANCES

6.1 ELECTRICITY BALANCES

Table 3 Electricity production in Serbia in the period from 2008. to 2014.

	Gross		
	Hydro GWH	Lignite GWh	Thermal GWh
2008	10,109.00	26,614.00	27,226.00
2009	11,144.00	26,833.00	27,178.00
2010	12,571.00	24,999.00	25,532.00
2011	9,243.00	28,672.00	29,357.00
2012	9,914.00	26,275.00	26,885.00
2013	10,853.00	28,620.00	29,024.00
Average 2008-2013	10,639.00	27,002.17	27,533.67
2014	11,617.00	22,073.00	22,437.00
2014/average	109%	82%	81%
2014-average	978.00	-4,929.17	-5,096.67

Table 4 Electricity consumption in Serbia in the period from 2008. to 2014.

	Consumption Hidro GWh	Consumption Pumping GWH	Consumption Thermal GWh	Consumption Mining GWh	Consumption Manufacturing GWh	Losses GWh	Final Consumption GWh
2008	53	878	2,360	409	46	5,903	27,258
2009	56	903	2,421	272	49	5,971	26,810
2010	96	1,049	2,251	179	241	6,024	27,569
2011	61	860	2,666	226	253	5,844	27,991
2012	63	874	2,453	414	206	5,609	27,167
2013	61	1,007	2,580	604	214	5,501	26,903
Average 2008-2013	65	929	2,455	351	168	5,809	27,283
2014	90	898	2,017	541	217	5,163	26,158
2014/average	138%	97%	82%	154%	129%	89%	96%
2014-average	25	-31	-438	190	49	-646	-1,125

6.1.1 Electricity imports and exports data and explanations

Calculation of net electricity imports and associated costs proved to be most difficult part of the analyses. Different data sources displayed large variation in recorded quantities which is probably also due to the inconsistent definition of imports and exports. Some data obviously contain also transit data, but yet again it's the definition of transit that does not enable calculation of "clean" export and import data. Transmission system operator (EMS) provides data on physical transits, but Statistical office data obviously do not contain data on physical transits. Data on contractual transits are not available online.

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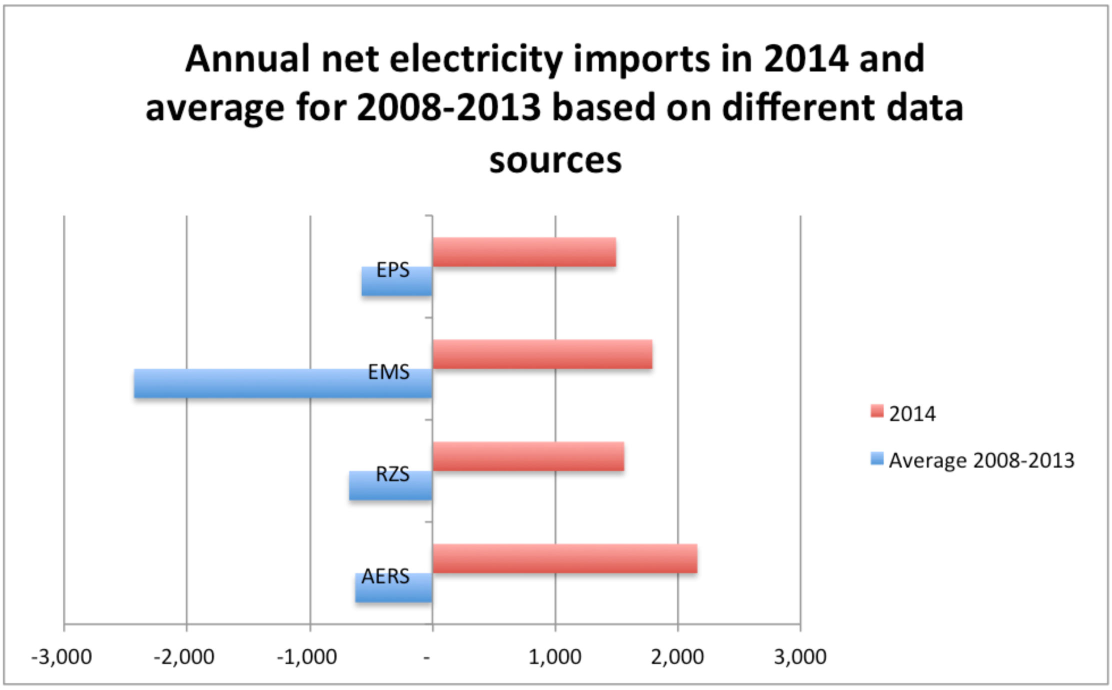

Figure 10 Annual net imports data from different data sources. [2]

Despite large differences in export and import data, net import quantities fall in a more narrow range than individual export or import data. In this analyses data from Statistical office have been used as main data source.

Table 5 Electricity exports and imports in Serbia. Source: Statistical Office

	Import GWH	Export GWH	Net Import GWH	Import 1000 USD	Export 1000 USD	Net Import 1000 USD
2008	8,875	8,802	73	202,005	157,317	44,688
2009	5,184	6,609	-1,425	143,965	200,470	-56,505
2010	5,620	5,917	-297	203,227	237,786	-34,559
2011	6,701	6,979	-278	168,231	180,237	-12,006
2012	5,781	5,392	389	228,399	125,901	102,498
2013	4,077	6,614	-2,537	159,913	271,640	-111,728
Average 2008-2013	6,040	6,719	-679	184,290	195,558	-11,269
2014	7,008	5,445	1,563	150,032	84,010	66,023
2014/ average	116%	81%	-230%	81%	43%	-586%
2014-average	968	-1,274	2,242	-34,258	-111,549	77,291

[2] EMS data for 2013. and 2014 only.

Table 6 Net electricity imports . Sources: Statistical Office (RZS), Regulatory Energy Agency (AERS), Electrical utility (EPS), Transmission utility (EMS)

	AERS (GWh)	RZS (GWh)	EMS (GWh)	EPS (GWh)
2008	26	73		-
2009	-1,398	-1,425		-1,425
2010	-255	-297		-297
2011	-264	-278		266
2012	440	389		426
2013	-2,323	-2,537	-2,432	-2,434
Average 2008-2013	-629	-679	-2,432	-577
2014	2,159	1,563	1,793	1,497
2014/ average	-343%	-230%	-74%	-259%
2014-average	2,788	2,242	4,225	2,074

6.2 COAL BALANCES

Table 7 Coal balances in the years 2008-2014.

Brown coal and lignite					(t)
	Production	Consumption in power plants	Import	Export	Net import
2008	38,702,258	35,472,470	249,563	164,261	85,302
2009	38,491,114	36,353,944	285,433	114,891	170,542
2010	37,976,157	34,785,049	324,176	114,242	209,934
2011	41,105,545	39,047,276	635,191	33,453	601,738
2012	38,233,971	35,969,041	479,428	26,629	452,799

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2013	40,297,123	37,862,986	305,760	52,841	252,919
Average 2008-2013	39,134,361	36,581,794	379,925	84,386	295,539
2014	30,010,288	28,758,111	460,124	13,962	446,162
2014/ average	77%	79%	121%	17%	151%
2014-average	-9,124,073	-7,823,683	80,199	-70,424	150,623

Lignite consumption in power plants is of particular importance for this analysis.

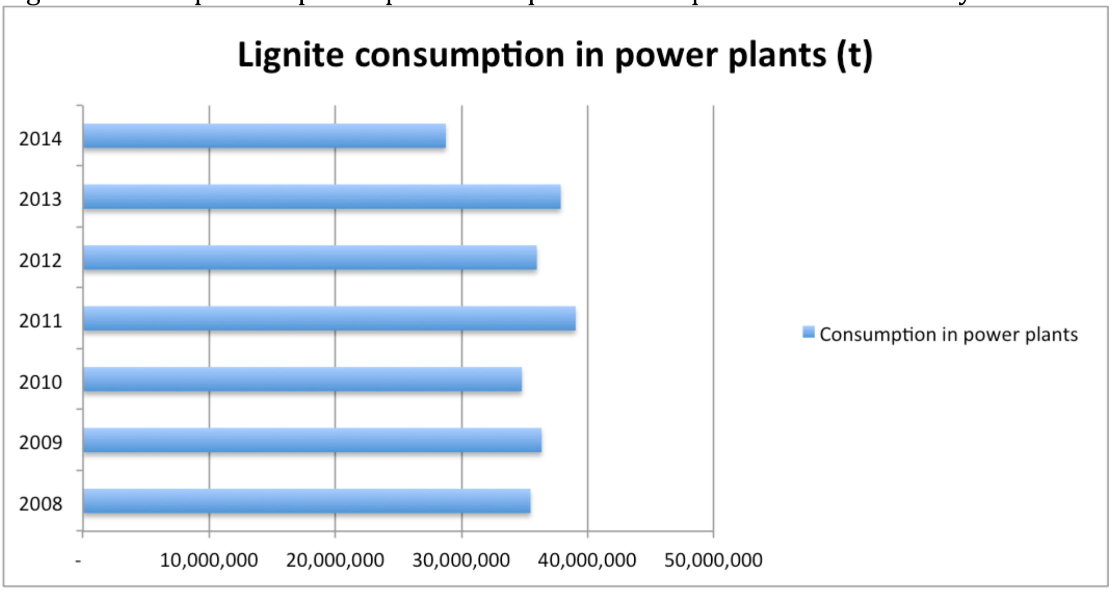

Figure 11 Lignite consumption in power plants from 2008. to 2014.

7 CO2 BALANCES

7.1 GHG EMISSIONS IN SERBIA

While we do not have official data on CO_2 emission form power sector alone, official data on emissions from fuel combustion are available for the 2010.-2013. period.

Table 8 GHG emissions from energy industries in Serbia. Source: Biannual Update Report, Draft.

Year	2010	2011	2012	2013

Emissions	34,122.91	37,190.07	32,989.09	34,338.47

These data contain also emissions stemming from other sources besides power sector, such as district heating, but lignite related emissions are most dominant emissions in this balance.

7.2 AVOIDED EMISSIONS IN 2014

Year	PD TENT- Obrenovac coal consumption (t)	TEKO- Kostolac coal consumption (t)
2008	28,564,618	7,200,000
2009	28,005,207	8,500,000
2010	27,890,905	7,179,000
2011	30,207,350	8,872,965
2012	28,414,279	7,677,150
2013	29,246,485	8,606,211
2014	23,144,662	5,613,744
2008-2013 Average	28,721,474	8,005,888
2014/ Average	81%	70%
2014-Average	-5,576,812	-2,392,144

Significant reductions of coal consumption occurred in 2014.reaching 19% of average 2008.-2013. consumption in Obrenovac and 30% in Kostolac.
As a result CO_2 emissions from lignite combustion in power sector have been reduced for more than 6.5 million tons comparing to average emissions in the 2008.-2013. period. Emissions factor that take into account reported calorific values in Kolubara have been used. Somewhat lower factor has been used for Kostolac.

Table 9 Avoided CO_2 emissions from lignite combustion in power sector in 2014.

Utility	Avoided CO2 emissions in 2014 in tCO2
Kostolac	2,069,108.59
PD Tent	4,454,930.89
Total	6,524,039.48

8 POWER SECTOR FINANCIAL DATA

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We have analyzed financial statements of the one mining utility RB Kolubara, combined mining and generation utility TEKO Kostolac, and generation utility PD TENT, all parts of EPS. In addition we have analyzed consolidated financial statements of EPS to extract pollution, rent and water usage fees.

Table 10 Profits of selected utilities

Profits in 000 EUR			
Year	TEKO	RB Kolubara	TENT
2008	-14,325	-1,539	-74,062.43
2009	9,220	19,414	-24,435.29
2010	14,149	23,466	32,883.54
2011	18,214	23,229	55,929.69
2012	-8,010	-24,201	8,662.55
2013	37,946	47,575	49,583.50
2014	29,012	31,811	42,557.21
2008-2013 Average	9,532	14,657	8,094
2014/ Average	304%	217%	526%
2014-Average	19,480	17,154	34,464

Table 11 Natural Resources Rent, Water Fees, Pollution Fees- EPS Group

Natural Resources Rent, Water Fees, Pollution Fees- EPS Group				
	Rent (000 EUR)	Pollution (000 EUR)	Water (000 EUR)	Total
2008	4,439.46	16,250.69	20,683.74	41,373.89
2009	5,000.92	39,691.62	21,660.97	66,353.51
2010	4,059.01	41,757.55	20,063.52	65,880.07
2011	5,886.68	32,574.98	17,637.50	56,099.15
2012	13,412.26	33,462.13	16,774.32	63,648.70
2013	17,951.98	39,771.37	17,951.98	75,675.33

2014	15,707.58	34,838.35	15,707.58	66,253.5 1
2008-2013 Average	8,458	33,918	19,129	61,505
2014/ Average	186%	103%	82%	108%
2014- Average	7,249	920	-3,421	4,748

It is interesting to see that so called “transfer prices” of coal and electricity that are used for internal transfers between utilities belonging to EPS have increased in 2014 for both coal and electricity.

Table 12 Calculated internal prices based on financial statements for PD Tent

	Net electricity sales price (EUR /MWH)	Coal purchase unit cost (EUR/ t)
2008	29.96	11.67
2009	30.66	11.52
2010	30.96	10.71
2011	33.12	11.65
2012	30.55	10.77
2013	29.55	12.97
2014	34.43	16.61
2008-2013 Average	30.80	11.55
2014/ Average	112%	144%
2014-Average	3.63	5.06

Table 13 Calculated internal prices based on financial statements for TEKO Kostolac

	Net electricity price (EUR MWH)
2008	32.91
2009	30.80
2010	36.70
2011	31.27
2012	33.88
2013	33.80
2014	46.83
2008-2013 Average	33.23
2014/2013	141%
2014-2013	13.61

9 CALCULATION OF ABATEMENT COSTS

9.1 METHODOLOGY DESCRIPTION

Total abatement costs have been calculated based on the differences between realized parameters in power sector in 2014. (and adjusted realized parameters) and parameters from counterfactual scenario. This counterfactual scenario is based on "average year". "Average year" parameters have been calculated as average values of selected set of data in the period form 2008. till 2013. Different sources of data have been consulted for creation of both "average year" and counterfactual scenario. These sources are: Statistical office of Serbia (RZS), Transmission system operator (EMS)., Electric power utility of Serbia (EPS), and Regulatory Energy Agency (AERS).
Additional set of data for 2014. has been created in which all parameters have been adjusted to those that would have been achieved if hydro power production has been equal to average production in the period from 2008. to 2013. This scenario is called

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hydro-adjusted scenario in this paper. Scenario that operates with actual parameters achieved in 2014. is called non hydro-adjusted scenario in this paper.

Figure 12 Methodology for identification of baseline set of data and scenario set of data

The difference in physical parameters between the 2014. (both hydro adjusted and non hydro-adjusted) and "average year" is essential for calculation of both total and per unit costs of reduced CO_2 emissions achieved in 2014. In order to estimate costs (and benefits) of 2014. changes (compared to "average year") we have been analyzing also the structure of vertically integrated power utility- EPS. Mining, electricity production and electricity wholesale were the functions analyzed.

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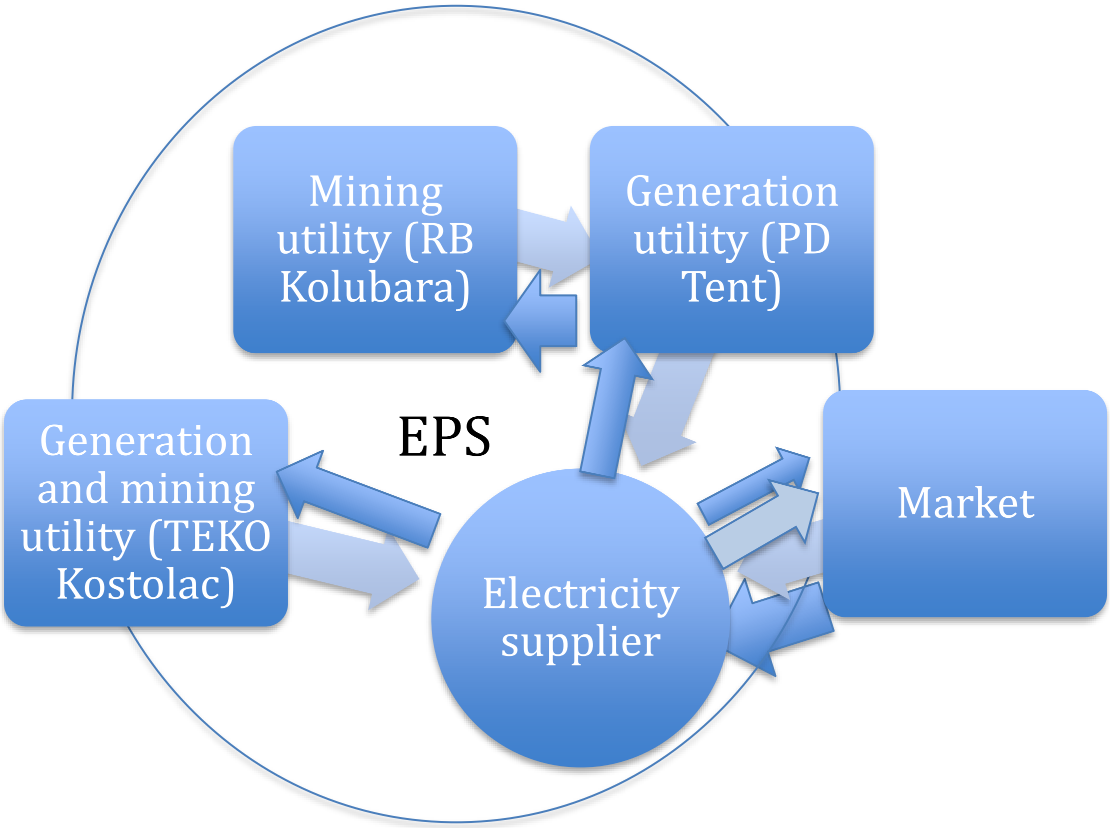

Figure 13 EPS, its utilities and market

Payment flow
Cash flow

EPS is vertically integrated company. We have decided to analyze its two generation utilities (PD TENT and TEKO Kostolac) running fleet of lignite power plants which saw significant reduction in lignite consumption and electricity output in 2014. Production of two utilities operating open pits for lignite excavation was relevant for our analyses. One is integrated with generation facilities in Kostolac (TEKO Kostolac) while the other (RB Kolubara) was separated legal entity and supplied generation facilities of PD TENT. Purchases, exports and imports of electricity at wholesale (high voltage) level were analyzed separately.

Basis for our calculations are presented in chapter 5 (6on page 14) where coal and electricity balances relevant for cost calculation are presented and in the chapter 7 (19) where financial basis are presented.

Here we have used the following calculation algorithm:

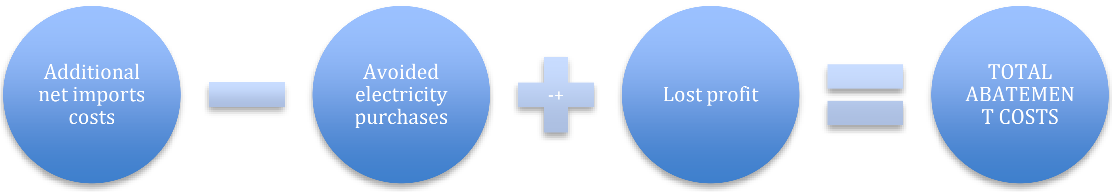

Figure 14 Calculation of total 2014 abatement costs.

9.1.1 Additional net import costs

Additional net import costs have been calculated in three scenarios for both average hydro adjusted and non-adjusted groups of scenarios.

Table 14 Explanation of additional net imports costs scenarios

Scenario	Costs calculation methodology
NI1	Total additional net imports costs in this scenario are equal to total additional net import costs based on data from Statistical Office of Serbia.
NI2	Total additional net import costs in this scenario are calculated using HUPX average base price for year 2014 and quantities of additional net imports based on Statistical office data.
NI3	Total additional net import costs in this scenario are calculated using 2014. German spot market base price as referent data and quantities of additional net imports based on Statistical office data.
NIA1	Total net imports costs in this scenario are equal to total net import costs data from Statistical Office of Serbia prorated to accommodate virtually increased additional net imports that would have occurred if hydro energy production had been equal to 6 years average.
NIA2	Total additional net import costs in this scenario are calculated using HUPX average base price for year 2014 and quantities of additional net imports based on Statistical office data and increased for 978 GWh to adjust for above average hydro electricity production that occurred in 2014.
NIA3	Total additional net import costs in this scenario are calculated using 2014. German spot market base price as referent data and quantities of additional net imports based on Statistical office data and increased for 978 GWh to

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	adjust for above average hydro electricity production that occurred in 2014.

Calculation has also been performed based on net import data from AERS and EPS but only results based on data form Statistical Office has been used in further calculations.

Table 15 Calculation of net additional imports costs in hydro non-adjusted scenarios

Additional annual net electricity imports in 2014					
		AERS	RZS	EPS	Unit Costs (EUR/MWh)
Costs (000 EUR)	Scenario NI1	63,556.45	63,556.45	63,556.45	N/A
	Scenario NI2	112,914.00	90,807.75	84,010.50	40.5
	Scenario NI3	89,216.00	71,749.33	66,378.67	32

Table 16 Calculation of net additional imports costs in hydro- average adjusted scenarios

Additional annual electricity imports in 2014 in GWh- hydro average adjusted					
		AERS	RZS	EPS	Unit Costs (EUR/MWh)
	Quantity in GWh	3,766	3,220	3,052	
Costs 000 EUR	Scenario NI1A	95,810	95,810	95,810	
	Scenario NI2A	152,523.00	130,416.75	123,619.50	40.5
	Scenario NI3A	120,512.00	103,045.33	97,674.67	32

9.1.2 Avoided electricity purchases

In average years in the base period (2008-2013) more electricity had been purchased from EPS generation utilities. Part of these purchases have been avoided in 2014. We calculate avoided purchases in the amount equal to additional net imports in non-hydro adjusted scenarios. In hydro adjusted scenario we calculate avoided purchase amount as equal to hydro average adjusted additional net imports. Shares of avoided purchases for each generation utility has been calculated using shares in actual 2014. purchases. Costs of these purchases have been calculated for several scenarios.

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Table 17 Description of scenarios for avoided purchases costs calculation

Scenario	Costs calculation methodology
AP1	Total avoided payments have been calculated using 2014. electricity prices paid to utilities based on the data extracted from financial statements as described in chapter 7 (19.) Total quantity of electricity used for this calculation equals to additional net imports in non ajusted scenario based on Statistical Office data. This quantity is then shared among the two utilities using their actual shares in total 2014. production.
AP2	Total avoided payments have been calculated using 2008.-2013. average electricity prices paid to utilities calculated based on the data extracted from financial statements (19.). Total quantity of electricity used for this calculation equals to additional net imports in non ajusted scenario based on calculation using Statistical Office data. This quantity is then shared among the two utilities using their actual shares in total 2014. production.
AP3	Total avoided payments have been calculated using 2008.-2013. average electricity prices paid to utilities calculated based on the data extracted from financial statements (19.) increased to account for unpaid externalities. Unpaid externalities have been calculated as diference between the external costs calculated for each of the plants in ECS sponsored study and per unit pollution payments paid by EPS. Total quantity of electricity used for this calculation equals to additional net imports in non ajusted scenario based on calculation using Statistical Office data. This quantity is then shared among the two utilities using their actual shares in total 2014. production.
AP1A	Total avoided payments have been calculated using 2014. electricity prices paid to utilities based on the data extracted from financial statements as described in chapter 7 (19.) Total quantity of electricity used for this calculation equals to additional net imports in hydro ajusted scenario based on Statistical Office data. This quantity is then shared among the two utilities using their actual shares in total 2014. production.
AP2A	Total avoided payments have been calculated using 2008.-2013. average electricity prices paid to utilities calculated based on the data extracted from financial statements (19.). Total quantity of electricity used for this calculation equals to additional net imports in hydro ajusted scenario based on calculation using Statistical Office data. This quantity is then shared among the two utilities using their actual shares in total 2014. production.
AP3A	Total avoided payments have been calculated using 2008.-2013. average electricity prices paid to utilities calculated based on the data extracted from financial statements (19.) increased to account for unpaid externalities. Unpaid externalities have been calculated as diference between the external costs calculated for each of the plants in ECS sponsored study and per unit pollution payments paid by EPS. Total quantity of electricity used for this calculation equals to additional net imports in hydro ajusted scenario based on calculation using Statistical Office data. This quantity is then shared among the two utilities using their actual shares in total 2014. production.

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Table 18 Costs of avoided purchases, non hydro-adjusted

Avoided purchases (000 EUR)		Kostolac	PD Tent	Total
	Scenario AP1	21,213.27	61,606.54	82,819.82
	Scenario AP2	15,049.56	55,106.42	70,155.99
	Scenario AP3	133,733.02	228,759.23	362,492.26

Table 19 Costs of avoided purchases, hydro-adjusted

Avoided purchases (000 EUR)		Kostolac	PD Tent	Total
	Scenario AP1A	30,466.19	88,478.41	118,944.60
	Scenario AP2A	21,613.96	79,143.03	100,756.99
	Scenario AP3A	192,065.40	328,540.64	520,606.03

9.1.3 Lost profit

Lost profit for companies “downstream” of electricity wholesale has been calculated to accommodate identification of their losses or benefits with public losses or gains. These are: PD TENT, TEKO Kostolac and RB Kolubara.

Three scenarios have been developed.

Table 20 Lost profit calculation methodology

Scenario	Lost profit calculation methodology
LP1	Lost profit has been calculated as difference between 2014. profit and average profit in the 2008.-2013. period. All profits have been calculated in Euros using exchange rates on the 31.December of the relevant year.
LP2	Lost profit has been calculated as difference between 2014. profit and 2013. profit . All profits have been calculated in Euros using exchange rates on the 31.December of the relevant year.
LP3	Lost profit has been assumed to be zero. Total abatement costs in these scenario reflect the abatement costs from the perspective of electricity supply business.

Table 21 Calculated lost profit

	Total lost profit in 000 EUR
LP1	-71,098
LP2	31,724
LP3	0

9.2 RESULTS

Table 22 Structure and amount of estimated abatement costs for hydro average non-adjusted scenarios

Costs of additional electricity imports		Avoided purchases		Lost profit		Abatement costs	
Scenario	Cost (000 EUR)	Scenario	Amount (000 EUR)	Scenario	Amount (000 EUR)	Total abatement costs (000 EUR)	Unit abatement costs (EUR per tCO2)
NI1	63,556	AP1	82,820	LP1	-71,098	-90,361	-14
NI1	63,556	AP1	82,820	LP2	31,724	12,460	2
NI1	63,556	AP1	82,820	LP3	-	-19,263	-3
NI1	63,556	AP2	70,156	LP1	-71,098	-77,697	-12
NI1	63,556	AP2	70,156	LP2	31,724	25,124	4
NI1	63,556	AP2	70,156	LP3	-	-6,600	-1
NI1	63,556	AP3	362,492	LP1	-71,098	-370,034	-57
NI1	63,556	AP3	362,492	LP2	31,724	-267,212	-41
NI1	63,556	AP3	362,492	LP3	-	-298,936	-46
NI2	90,808	AP1	82,820	LP1	-71,098	-63,110	-10
NI2	90,808	AP1	82,820	LP2	31,724	39,712	6
NI2	90,808	AP1	82,820	LP3	-	7,988	1

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NI2	90,808	AP2	70,156	LP1	-71,098	-50,446	-8
NI2	90,808	AP2	70,156	LP2	31,724	52,375	8
NI2	90,808	AP2	70,156	LP3	-	20,652	3
NI2	90,808	AP3	362,492	LP1	-71,098	-342,782	-52
NI2	90,808	AP3	362,492	LP2	31,724	-239,961	-37
NI2	90,808	AP3	362,492	LP3	-	-271,685	-42
NI3	90,808	AP1	82,820	LP1	-71,098	-63,110	-10
NI3	71,749	AP1	82,820	LP2	31,724	20,653	3
NI3	71,749	AP1	82,820	LP3	-	-11,070	-2
NI3	71,749	AP2	70,156	LP1	-71,098	-69,504	-11
NI3	71,749	AP2	70,156	LP2	31,724	33,317	5
NI3	71,749	AP2	70,156	LP3	-	1,593	0
NI3	71,749	AP3	362,492	LP1	-71,098	-361,841	-55
NI3	71,749	AP3	362,492	LP2	31,724	-259,019	-40
NI3	71,749	AP3	362,492	LP3	-	-290,743	-44

Table 23 Structure and amount of estimated abatement costs for hydro average adjusted scenarios

Costs of additional electricity imports	Avoided payments	Lost profit	Abatement costs

Scenario	Cost (000 EUR)	Scenario	Amount (000 EUR)	Scenario	Amount (000 EUR)	Total abatement costs (000 EUR)	Unit abatement costs (EURpoer tCO2)
NI1A	95,810	AP1A	118,945	LP1	-71,098	-94,232	-14
NI1A	95,810	AP1A	118,945	LP2	31,724	8,589	1
NI1A	95,810	AP1A	118,945	LP3	-	-23,134	-4
NI1A	95,810	AP2A	100,757	LP1	-71,098	-76,045	-12
NI1A	95,810	AP2A	100,757	LP2	31,724	26,777	4
NI1A	95,810	AP2A	100,757	LP3	-	-4,947	-1
NI1A	95,810	AP3A	520,606	LP1	-71,098	-495,894	-76
NI1A	95,810	AP3A	520,606	LP2	31,724	-393,072	-60
NI1A	95,810	AP3A	520,606	LP3	-	-424,796	-65
NI2A	130,417	AP1A	118,945	LP1	-71,098	-59,626	-9
NI2A	130,417	AP1A	118,945	LP2	31,724	43,196	7
NI2A	130,417	AP1A	118,945	LP3	-	11,472	2
NI2A	130,417	AP2A	100,757	LP1	-71,098	-41,438	-6
NI2A	130,417	AP2A	100,757	LP2	31,724	61,383	9
NI2A	130,417	AP2A	100,757	LP3	-	29,660	5
NI2A	130,417	AP3A	520,606	LP1	-71,098	-461,287	-70
NI2A	130,417	AP3A	520,606	LP2	31,724	-358,466	-55
NI2A	130,417	AP3A	520,606	LP3	-	-390,189	-60
NI3A	103,045	AP1A	118,945	LP1	-71,098	-86,997	-13

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NI3A	103,045	AP1A	118,945	LP2	31,724	15,824	2
NI3A	103,045	AP1A	118,945	LP3	-	-15,899	-2
NI3A	103,045	AP2A	100,757	LP1	-71,098	-68,809	-11
NI3A	103,045	AP2A	100,757	LP2	31,724	34,012	5
NI3A	103,045	AP2A	100,757	LP3	-	2,288	0
NI3A	103,045	AP3A	520,606	LP1	-71,098	-488,658	-75
NI3A	103,045	AP3A	520,606	LP2	31,724	-385,837	-59
NI3A	103,045	AP3A	520,606	LP3	-	-417,561	-64