EXPERT OPINION ON THE AMENDED INVESTMENT PLAN REV. 5 – CONSTRUCTION OF THE 600 MW REPLACEMENT UNIT 6 IN ŠOŠTANJ THERMAL POWER PLANT (ŠOŠTANJ TPP)

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1. INSTEAD OF AN INTRODUCTION

On 12 October and 29 October 2012, Greenpeace Slovenia and Focus Association for Sustainable Development commissioned an expert opinion on the Amended Investment Plan Rev. 5 (AIP5), "Construction of the 600 MW Replacement Unit 6 in Šoštanj TPP". They sought to answer the following five questions:

- **Have the calculations of the net present value (NPV) and internal rate of return (IRR) in the existing amended investment plan been implemented correctly?**
- **If and how does the calculation take into account financing cost?**
- **How sensitive is the project to changes in electricity prices and revenues from the sales of electricity?**
- **How sensitive is the project to changes in lignite prices?**
- **How sensitive is the project to changes in the price of emission allowances?**

The analysis is based on our own structure of individual calculations, with the transcription of the input data which the project sensitivity analysis was based on. The study verifies whether the use of input data in financial projections was correct (questions 1 and 2) and explores the changes that occurred in the financial projections due to different input data (questions 3, 4, 5). The study only provides answers to the questions listed above. The analysis does not include other assessments; therefore we did not take a position on other issues. I derived the answers to the questions above from the sources and literature listed, and from the hypothesis that the other claims, data, and clarifications on the client's part were accurate (for example, data disclosed via e-mail). The report consists of 18 pages and is intended for the final customer (Greenpeace Slovenia, Focus).

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2. CALCULATION OF THE ECONOMIC FLOW OF THE PROJECT BASED ON THE INPUT DATA AND ASSUMPTIONS OF AIP5

In order to calculate the financial and market performance, AIP5 provided an economic flow of the project, covering the period of the project and a 40-year period of operation (economic life of the project). Economic inflow consists of revenue from the sales of electric and thermal power, revenue from ash and gypsum sales, and income from ancillary services. Economic outflow consists of the investment value (excluding financing costs), operating costs (disregarding depreciation and financing costs) and income taxes generated by the project. A discount rate of 7 % was used (AIP5, 2012, p. 44).

The investment plan (AIP5) provided a calculation of the investment economics for a 40-year period of operation with the electricity sales price and prices of emission allowances as indicated in the AIP. The calculated net present value (NPV[1]) amounted to 112.9 million EUR (at a 7 % discount rate), the internal rate of return (IRR[2]) to 7.75 %, and the return on equity (ROE[3]) to 14.79 % (AIP5, 2012, p. 44). With such input data, the project is acceptable. The investment repayment period is shorter than the economic life of the project, the NPV is positive, the IRR is higher than the funding costs, and the return on equity exceeds the return that should be required by sectoral policy for energy projects in the Republic of Slovenia (above 9 %[4]). The calculation shows that the main investment objectives defined on page 9 of AIP5 (2012), to achieve an IRR higher than 7 % and a return on equity higher than 10 %, had been achieved.

Table no. 1: Results of the economic performance calculation in AIP5

Repayment period (in years)	15
NPV with 7 % discount rate (million EUR)	112.9
IRR (in %)	7.75
Return on equity (ROE) (in %)	14.97

Source: AIP5, 2012, p. 44

Our calculations also confirm the correctness of the calculations above, with the same input data and the same assumptions (disregarding depreciation, disregarding financing costs).

[1] NPV means that investment expenditure and revenues are discounted at today's date in the economic flow of the project. Discounting ensures that the amounts become mutually comparable. A negative NPV means that the sum of discounted inflows does not cover the sum of discounted outflows throughout the duration of the project. An investment is acceptable only when the NPV is positive.

[2] IRR is the discount rate at which NPV equals zero. IRR tells us the interest rate the investor can pay for a loan without incurring a loss if the entire investment is financed by a loan. As a rule, IRR is compared to the required rate of return. If the required rate of return is lower than the IRR, then the investment is acceptable.

[3] Return on equity equals net income divided by equity. It is profit in terms of resources provided by the shareholders.

[4] At the third regular session of the Government of the Republic of Slovenia on 23 February 2012, it was decided that all the conditions for profitability of a project must be in line with the sectoral policy for the energy industry (AIP5, 2012, p. 10).

KMPG's audit (2012) of AIP5 came to a similar conclusion. **In both cases it was established that the mathematical calculation of the economic performance of the investment, taking into account the default values of the input data, was technically correct (NPV, repayment period, IRR),** with the comment that the calculation of the economic flow of already implemented investments had been simplified, because they were not allocated to the years in which they were actually incurred, and because they were not discounted by a discount rate, which would lower the NPV. AIP5 does not provide the information in which years the previous investments had been carried out. Therefore, we calculated the NPV of 79.523 million EUR and the IRR of 7.48 % under the assumption that the entire sum of 589.793 million EUR had been invested in the previous year (2011), while all other elements remained unchanged.

A 7 % discount rate has been used in the calculations, as required by the Decree on the uniform methodology for the preparation and treatment of investment documentation in the field of public finance. However, it is written in the sectoral policy on energy development in the Republic of Slovenia (Ministry of the Economy, 2011, p. 46) that a **minimum 9 % discount rate** should be used for investments in facilities for the production of electric power from fossil fuels. The authors of AIP5 refer to this document in assessing the return on equity (AIP5, p. 46), but not in determining the discount rate. Even KPMG's review (2012, p. 16) only deals with the accuracy of the calculation with a 7 % discount rate, but fails to take a particular stand on the appropriateness of the amount. The authors of the review believe that a more precise determination of an appropriate discount rate exceeds the scope of the review and also intrudes upon the sphere of planning energy policies (2012, p. 16).

The two requirements regarding the height of the discount rate are not antagonistic. The Decree defines a minimum discount rate in the field of public finance (7 %), while the sectoral policy on the energy industry sets a minimum discount rate at the industry level (9 %). The table below shows a calculation of the NPV with a 9 % discount rate, while other assumptions remain the same as in AIP5. **At a 9 % discount rate, the NPV is negative (-167.128 million EUR). In such a case, the project is not economically justified.**

Table no. 2: NPV with a discount rate as required by the sectoral policy for energy development in the Republic of Slovenia

	9 % discount rate
NPV (million EUR)	-167.128

Source: Own calculations.

3. FINANCING COST AND SENSITIVITY ANALYSIS

An economic flow of the project was drawn up in order to calculate the financial and market performance. Economic inflow consists of revenue from the sales of electric and thermal

power, revenue from ash and gypsum sales, and income from ancillary services. Economic outflow consists of the investment value (excluding financing costs), operating costs (disregarding depreciation and financing costs) and income taxes generated by the project (AIP5, 2012, p. 44).

The estimated value of the investment amounts to 1,302 million EUR, with the cost of financing during construction at 82.096 million EUR (AIP5, 2012, p. 38). Due to this cost, the investment in the economic flow (AIP, 2012, Annex 5, p. 191) differs from the estimated value of the investment (AIP, 2012, p. 38). On page 38, the authors of AIP5 state that the investment amounts to 1,302.492 million EUR. At the same time, Annex 5 clearly shows that the outflows (investment, already realised) amount to 1,220.394 million EUR. The authors of AIP5 explain under the table on page 44 (AIP5, 2012) that the financing cost (during construction) is not taken into account in the economic flow of the project. Due to the changed conditions in the financial markets, which are reflected in the decline of Euribor and consequentially in the level of long-term interest rates, the financing cost in AIP5 during construction (82.096 million EUR), compared to AIP4 (128.67 million EUR), is 46.46 million EUR lower (AIP5, 2012, p. 209).

For this reason, a dilemma regarding risk management occurs in the analysis of AIP5 as a result of revised policies for hedging interest rates. In terms of the financing cost of the project, it is important to emphasize the impact of the changed structure of financial resources on the interest rate risk. In the AIP4 investment programme, ŠTPP anticipated financing costs pursuant to the planned deadlines for the issue of the loan guarantees for EIB, to the resulting anticipated drawing of the EBRD loan, and to the movement of interest rates at that time. In AIP4, ŠTPP also anticipated all the financial charges on loans to be at a fixed interest rate by obtaining, to assess long-term interest rates, indicative offers for hedging interest rates for the entire duration of the loans (AIP5, 2012, p. 209). In AIP5, ŠTPP will control risk associated with changes in interest rates by drawing 50 % of the loans at a fixed interest rate and 50 % at a floating interest rate (AIP5, 2012, p. 209). In accordance with the new policies for hedging interest rates, ŠTPP had prepared a new estimate of the financing cost in AIP5. Therefore, it would be reasonable for AIP5 to include a sensitivity analysis of the cash flow of the project to the movement of interest rates.

AIP4 and AIP5 foresaw three loans (EIB 550 million, EBRD 200 million, HSE 83 million) in the total amount of 833 million EUR. **A significant difference in terms of interest rate risk should be noted at this point.** In AIP4, the loan structure in terms of the nature of the interest rates was as follows (AIP5, 2012, p. 209, 210):

- 13 % of total loans at floating interest rates,
- 87 % of total loans at fixed interest rates.

In AIP5 (2012, p. 211, 212), the loan structure in terms of the nature of the interest rates is as follows:

- 50.5 % of total loans at floating interest rates,
- 49.5 % of total loans at fixed interest rates.

The data above shows that the financing costs during construction had mainly been lowered due to the increase in the share of loans with a floating interest rate and due to the decline of Euribor rates. The latter experienced a sharp decline from AIP4 in August 2011 (6 months Euribor rate at 1.82 %) to AIP5 in September 2012 (6 month Euribor rate at 0.533 %), which contributed significantly to the reduction of the financing cost itself.

Table no. 3: Movement of the 6m (6 months) Euribor rate

Date	Euribor on first day of the month in 2012	Year	Euribor on first day of the month by year
1. 2. 2012	1.409	2003	2.794
1. 3. 2012	1.267	2004	2.151
2. 4. 2012	1.072	2005	2.209
2. 5. 2012	0.992	2006	2.643
1. 6. 2012	0.943	2007	3.857
2. 7. 2012	0.928	2008	4.703
1. 8. 2012	0.664	2009	2.945
3. 9. 2012	0.553	2010	0.996
1. 10. 2012	0.438	2011	1.224
1. 11. 2012	0.387	2012	1.606

Source: http://www.euribor-rates.eu/euribor-rate-6-months.asp

However, the risk due to potentially higher future floating interest rates has increased at the same time. The investment according to AIP5 is far more exposed to interest rate risk than AIP4 due to a higher share of loans with a floating interest rate. Therefore, it would be necessary to perform an analysis of sensitivity to interest rates higher than the current interest rates. Such an analysis cannot be found in AIP5; however, it is possible to conclude from Table no. 3 that, in comparative terms, the current level of the six-month Euribor is at historically low levels. In the event that the 6m Euribor rate increases by as little as 1 %, the risk that ŠTPP exposed itself to with the amended policy for hedging interest rates can significantly exceed the savings generated by the amended policy for hedging interest rates.

4. SENSITIVITY ANALYSIS REGARDING CHANGES IN THE PRICE OF ELECTRICITY AND REVENUE

A particular feature of electric power is that it cannot be stored. The electricity market is a market where supply and demand are confronted. The consumption of electric power in the Republic of Slovenia is determined as the sum of electric power needs of particular individual consumers (households, industry, and others). Electric production or supply is defined as a sum of all domestic and foreign (import) production units that meet the demand. Short-term and long-term calculations of the price of base load electricity in Europe can be based upon long-term futures contracts at a nearby working and liquid trading market for energy, EEX in

Leipzig, Germany. The latter plays a key role in determining prices of electricity in the Republic of Slovenia (AIP5, 2012, p. 65).

In the AIP5 study, the price of electricity was set at 63.50 EUR/MWH in the year 2015 and at 150.81 EUR/MWH in 2054 (AIP5, 2012, p. 158). The authors of the study had set the price according to the NEP. The document only predicts prices until 2030; therefore, the changes that were used for predicting the prices until 2054 were the same as the average changes in the entire period of the predictions in the NEP (AIP5, 2012, p. 84).

In the AIP5 project (2012, p. 166), a sensitivity analysis regarding the following changes of electricity prices was made:

- Increase of electricity prices by 10 % and 15 %,
- Decrease of electricity prices by 10 % and 15 %.

Table no. 4: Sensitivity analysis regarding the sales price of electricity

	+15 %	+10 %		-10 %	-15 %
NPV (in million EUR)	522.381	385.887	112.900	-160.246	-298.590
IRR	10.16	9.39	7.75	5.86	4.76
Return on Equity (%)	22.12	19.44	14.97	8.73	6.04

Source: AIP5, 2012, p. 166.

The authors of the study find that the project is relatively highly sensitive to prices of electricity (AIP5, 2012, p. 167). For example, even when the price decreases by only 10 %, the NPV is negative and the IRR is 5.86 %. A 15 % price decrease makes matters even worse.

Based on the same input data and assumptions (disregarding depreciation and financing costs), our calculations have also confirmed the correctness of the projections above. The movements of the price of electricity are extremely difficult to predict. The medium-term and long-term price of electricity depends on a multitude of factors that are difficult to determine.[5] Some of them increase, while others decrease the price of electricity. It is therefore somewhat impossible to predict the price of electricity.

The authors of the study also admit the latter (AIP5, 2012, p. 84). Nevertheless, the authors are certain that the factors that increase the price of electricity will prevail. They believe that the likelihood of downward price trends is low due to scepticism of the general public toward the nuclear energy programme and due to the problem of nuclear safety (Fukushima). Despite reduced consumption following the current crisis, the maximum annual production of the electric power system in Slovenia is lower than the annual consumption (negative energy balance in Slovenia); therefore, the prices will presumably be higher in the future. Therefore,

[5] Prices of electricity change due to (1) increased electricity consumption, (2) GDP and employment growth, (3) population growth, (4) changes in the development of specific industry sectors within a country, (4) technological progress and relatively lower energy consumption, (5) increased investments in energy infrastructure, (6) greater share of renewable energy sources, (7) political decisions and international agreements regarding the reduction of greenhouse gas emissions, (8) changes in primary fuel prices (coal, oil, gas) etc.

the project predicts a constant increase of the price of electricity. A review of all previous investment plans shows how much the price has increased (AIP5, 2012, p. 11–18). For example, the price of electricity from the pre-investment concept (July 2005) until the Investment Plan Rev. 3 (October 2009) had increased from 43.75 EUR/MWH to approximately 71.5 EUR/MWH, which is an increase of almost 63 %.

The KPMG review concludes that the price projection from the NEP should be supplemented with other sources (2012, p. 8), due to the unpredictability and uncertainty of the current situation. The authors of AIP5 also admit that various scenarios could be made (AIP5, 2012, p. 84). By using input data from the NEP, the authors of AIP5 aimed to avoid a debate on the correctness of the prices used in the calculation of the investment's economic viability. Our additional calculation assumes that the revenue from the sale of electricity decreases by 10 % due to either lower prices of electricity or reduced production. The table below shows a sensitivity analysis in case of such a scenario.

Table no. 5: Calculation of the NPV with a 10 % decrease of revenue from the sales of electricity and at a 9 % discount rate

	9 % discount rate
NPV (million EUR)	-429.046

Source: Own calculations.

The calculation shows that when the revenue from the sales of electricity decreases by 10 %, the NPV is even more negative at 9 % discount rate (-429.046 million EUR). This means that the project is not economically viable. The analysis above shows that the project is strongly sensitive to the price of electricity.

5. SENSITIVITY ANALYSIS REGARDING THE PRICE OF COAL (LIGNITE)

The AIP5 study sets the coal price in 2015 at 2.25 EUR/GJ and at 2.73 EUR/GJ in 2054 (AIP5, 2012, p. 158). The project in AIP5 (2012, p. 165) included a sensitivity analysis regarding the price of coal:

- Increase of the coal price by 10 % and 20 %,
- Decrease of the coal price by 10 % and 20 %.

Table no. 6: Sensitivity analysis regarding the price of coal

	-20 %	-10 %		+10 %	+20 %
NPV (million EUR)	238.091	175.495	112.900	50.305	-12.290
IRR (in %)	8.54	8.15	7.75 %	7.34	6.92
Return on Equity (in %)	16.30	15.19	14.97	12.98	11.87

Source: AIP5, 2012, p. 165.

The authors of the study estimate that the project is relatively insensitive to the price of coal (AIP5, 2012, p. 165). At a 10 % increase of the price of coal, the NPV stays positive, while the IRR is at 7.43 %. The project is acceptable with such input data. However, at a 20 % increase of the price of coal, the NPV is negative (-12.29 million EUR), the IRR is at 6.92 %, and the return on equity decreases to 11.87 %. Due to the negative net present value, the project is not acceptable.

Our calculations, using the same input data and assumptions (disregarding depreciation and financing costs), also confirm the calculations above. **However, if we take into account the 9 % discount rate stipulated in the sectoral policy for the energy industry in the Republic of Slovenia (ME, 2011, p. 46) and use the same input data, the NPV would be negative (-228.4 million EUR) if the price of coal increased by 10 %. The project would become unacceptable.**

Table no. 7: Calculation of the NPV with a 9 % discount rate and a 10 % increase of the price of coal

	9 % discount rate
NPV (million EUR)	-228.401

Source: Own calculations.

The lignite used for the operation of ŠTPP6 is supplied from the nearby Velenje Coal Mine; therefore, the authors of different studies believe that the possibility of changes in the price of coal is relatively low (AIP5, 2012, p. 165; Bruyn et al., 2011, p. 5). The first reason is that the lignite is of relatively low quality in terms of calorific value, and economical transport is therefore not possible. Its price is therefore strongly locally conditioned and determined. The second reason is the ownership; ŠTPP and the Velenje Coal Mine are owned by the same owner. This opens up the option of mutual attrition through cross-subsidization, be it to the detriment of the coal mine or to the detriment of ŠTPP. If the purchase price of coal is set too low, this could cause the coal mine to have poor economic results at the expense of ŠTPP. The Delft study (Bruyn et al., 2011, p. 5, 6) points out that the coal price of 2.25 EUR/GJ is accessible only through cross-subsidization. Without it, the lignite price would be at around 2.62 EUR/GJ in 2015, which would increase the annual costs by 50–70 million; this is similar to the present coal price of 2.56 EUR/GJ. **There is considerable doubt whether the coal price could be lowered from the present 2.56 EUR/GJ to 2.25 EUR/GJ.**

The Velenje Coal Mine and ŠTPP are, because of their close proximity and joint ownership by HSE, closely connected business entities. In this respect, if the purchase price of coal is set too low, this could mean that the coal mine is subsidizing ŠTPP; if the price is set too high, ŠTPP would be subsidizing the coal mine. The only difference is the matter of distributing the benefits and costs between the Velenje Coal Mine and ŠTPP. But if we think of ŠTPP and the Velenje Coal Mine as two perfectly independent business entities, it would be **reasonable and necessary to analyse the project of using alternative coal (imported) in greater detail and to analyse the project of renovating Units 4 and 5.**

Unlike electricity prices, which have been increasing constantly, the price of coal has stayed the same in all revisions of the investment plan. A review of all the previous investment plans shows the changes in the price of coal. In the pre-investment concept of July 2005, the investment economics for a 40-year operation period were calculated with the coal price at 26.2 EUR/ton. Assuming the calorific value is 11.5 MJ/kg, this means that the price is 2.28 EUR/GJ or 22.9 EUR/ton, which means 1.99 EUR/GJ at the same calorific value. In the amended investment plan of July 2006 (Rev. 1) and the investment plan of October 2009 (Rev. 3), the price of 2.25 EUR/GJ was used. At the same time, the authors of AIP4 and AIP5 used identical coal prices in the period from 2016 to 2054. The price in AIP5 and AIP4 will decrease from this year's 2.56 EUR/GJ to 2.25 EUR/GJ in 2015, and then gradually increase to 2.73 EUR/GJ in 2054.

A comparison to the movement of electricity prices introduces a certain amount of doubt regarding the correctness of the input data. The authors (AIP5, 2012, p. 66, 67) state that the electricity prices are mainly influenced by prices of primary energy sources (oil, gas, coal). For example, the price of coal increases by 21 % between 2015 and 2054, and the price of electricity by as much as 137 % (AIP5, 2012, p. 158). The AIP5 study predicts a decrease of the price of coal between 2012 and 2015, from 2.56 to 2.25 EUR/GJ, while the electricity price in the same period increases from 62.5 to 63.5 EUR/MWh. In 2016, the difference in price movement becomes even more evident. The coal price increases only slightly from 2.25 EUR to 2.26 EUR/GJ, while the electricity price increases from 63.5 to 74.9 EUR/MWh. These movements undoubtedly have a positive influence on the economics of the AIP5 project, but they are not adequately explained in AIP5, therefore there is serious concern regarding the accuracy of the assumptions in AIP5.

The price of coal remains relatively unchanged in all investment plans. But a calculation of the share of coal costs in the revenue from the sales of electricity shows the latter is constantly decreasing from 30 % in 2015 to 15 % in 2054. This decrease by half may be the result of greater efficiency. The latter is not substantiated in AIP5. What is more realistic is an opposite trend of a diminished output due to supplies running out in the Velenje Coal Mine. This is also described in the Delft study (2011, p. 13).

Article 3 of the long-term contract between business unit ŠTPP and HSE on the purchase of coal, lease of power, and purchase of electric power of 12 October 2009 reads: "The contracting parties agree that the trigger coal price in 2015 is 2.25 EUR/GJ. Prices for each calendar year will be determined upon anticipated quality of coal, electricity prices on the market, and comparable coal prices on other markets, with transport costs and other costs included." This means that the contract only determines a fixed price of coal for 2015. Due to (1) an accelerated pace of an unexplained lag in the growth of coal prices in comparison with electricity prices, (2) lack of an explanation regarding the greater efficiency of the power plant, (3) the coal price in the long-term contract on the purchase of coal, lease of power, and purchase of electric power between business unit ŠTPP and HSE only being determined for 2015, the long-term price of coal needs to be determined more precisely.

At its 3rd regular session of 23 February 2012, the Government adopted a decision that a contract on the long-term supply of lignite at the maximum price from AIP4, which is 2.25 EUR/GJ (AIP5, 2012, p. 9), must be concluded between ŠTPP6 and the Velenje Coal Mine prior to the approval of a government guarantee. Government decision no. 2 states: "Prior to the approval of a government guarantee, ŠTPP and the Velenje Coal Mine must conclude a contract on the long-term supply of lignite at the maximum price from AIP4 (2.25 EUR/GJ)". It is not clear from this government decision whether the contract should be concluded at fixed price of 2.25 EUR/GJ for the entire service life of ŠTPP6 or if the contract should have the consequence of obliging both parties to the prices determined in AIP4 for each year in particular. The latter is more likely, but ŠTPP6 did not oblige itself to one nor the other with the existing annex.

Due to the government decision, an annex has been added which states in Article 2: "… In accordance with the above, the contracting parties commit to the trigger price of coal for 2015 at 2.25 EUR/GJ. Subject to the foregoing, the contracting parties also agree that the price in subsequent years, that is until 2054, is to be determined in accordance with the Amended Investment Plan for the Construction of the 600 MW Replacement Unit 6 in Šoštanj Thermal Power Plant (AIP4)." We believe that the latter does not fully meet the government decision regarding the conclusion of a long-term coal supply contract at fixed prices. **The long-term contract should guarantee the price for the entire service life of the power plant. On the contrary, the contract only determines the price for 2015.** Even after the government had demanded a long-term contract to be concluded, ŠTPP and the Velenje Coal Mine only concluded an annex that does not determine fixed prices. One of the possible causes is that the Velenje Coal Mine is avoiding fixing the price at 2.25 EUR/GJ and at price levels determined in AIP4.

6. SENSITIVITY ANALYSIS REGARDING EMISSION CREDIT COSTS

The European Union Emissions Trading Scheme which came into force in 2005 is the largest emissions trading scheme in the world. In the first period, the emission allowances were free of charge (2005–2012), and in the next period from 2013 to 2020, they will be free of charge for the industrial sector whereas companies from the electricity industry will have to buy the entire amount of their allowances at auctions, since they produce more than 56 % of the overall emissions.

In the AIP5 study, the emission credit price is set upon the carbon prices of 5.15 EUR/t CO2 for 2012 and 82.47 EUR/t CO2 for 2054 (AIP5, 2012, p. 158). The emission credit prices were estimated according to the NEP, after the project operators had stated that the expert and general public had no major objections to the proposed document. The prices included in the document are provided only until 2030, therefore, both items that can be projected by the NEP (AIP5, 2012, p. 84) and calculated as an average change during the entire period, were equally

changed and used to calculate the price until the year 2054. The AIP5 (2012, p. 165) includes an evaluation of the project sensitivity to:

- The increase of the selling price of emission credits by 10 % and 20 %;
- The reduction of the selling price of emission credits by 10% and 20%.

Table no. 8: Sensitivity analysis regarding emission credit price

	+20 %	+10 %	Baseline scenario	-10 %	-20 %
NPV (million EUR)	-57.239	27.830	112.900	197.970	283.040
IRR	6.6	7.19	7.75	8.27	8.77
Return on equity	10.24	12.16	14.97	16.01	17.94

Source: AIP5, 2012, p. 167.

Based on the same input data and assumptions (disregarding depreciation and financing costs), our calculations have also confirmed the correctness of the projections above. If the calculations of the NPV and IRR consider a 10 % increase of the emission credit price, whereas all other items of the calculation are identical to the ones used in AIP5, the NPV would decrease to 27.830 million EUR and the IRR to 7.19 %. According to the calculation, a decrease of the NPV and IRR is therefore expected. The table above shows that an increase of the carbon price by 20 % results in a negative NPV of the project (-57.23 million EUR).

Considering a discount rate of 9 % in the NPV and IRR calculations, as stipulated by the sectoral policy for the energy industry in the Republic of Slovenia (ME, 2011, p. 46), and under the assumption that all other items of the calculation stay the same as in AIP5, an increase of the emission credit price by 10 % results in a negative NPV (-246.118 million EUR).

Table no. 9: NPV calculation based on a 9 % discount rate and an increase of the CO2 emission credit price by 10 %

	9 % discount rate
NPV (million Euro)	-246.118

Source: Own calculation

The authors of the review provided by KPMG (2012, p. 17) also found that the NPV and IRR markers are highly sensitive to the emission credit selling price. An increase of the price by 20 %, for example, results in a negative NPV. By determining emission credit prices according to the NEP, the authors of the AIP5 were aiming to avoid further discussions about the economic viability of the investment. At this point, the authors of the AIP5 study had predicted a number of different scenarios (AIP5, 2012, p. 84). In addition, the AIP5 review (2012, p. 8) also suggests taking into account the projections of important analysts regarding the expected carbon price index for the entire service life of the investment. According to AIP5 (2012, p. 72), the CO2 emission credit price is extremely difficult to determine.

However, due to (1) the high degree of uncertainty about the fluctuation of emission credit prices in the future, and (2) the sensibility of the Šoštanj TPP to the fluctuation of allowance

prices and their influence on variable costs, it seems reasonable to conduct further analyses regarding the sensitivity of the Unit 6 project in TPP to emission credit prices. Based on the latter, alternative scenarios for the expected price index of emission credits have been considered in our study.

The fluctuation of CO2 emission credit prices in the future has been summarized according to the European Commission report (Energy Roadmap 2050, p. 35). The report presents seven different scenarios. Our projection is based on five »decarbonisation« scenarios, since only these comply with the EU's long-term goals for the reduction of greenhouse gas emissions.

Table no. 10: CO2 emission credit prices according to different scenarios until 2050 (in EUR/t CO2)

Scenario	2012	2020	2030	2040	2050
Scenario no. 1 (High Energy Efficiency Scenario[6])	8	15	25	87	234
Scenario no. 2 (Diversified Supply Technologies Scenario[7])	8	25	52	95	265
Scenario no. 3 (High RES Scenario[8])	8	25	35	92	285
Scenario no. 4 (Delayed CCS Scenario[9])	8	25	55	190	270
Scenario no. 5 (Low nuclear Scenario[10])	8	20	63	100	310

Source: Adapted from Energy Roadmap 2050, pages 26, 27, 35

All five scenarios have been generated under the assumption that Europe has made a commitment to reduce greenhouse gas emissions by 80 % until 2050 with regard to the reference year 1990, or to reduce CO2 emissions by 85 % until 2050 (40 % until 2030), in order to achieve the global objective of limiting temperature rise by 2°C compared to the pre-industrial period (Energy Roadmap, 2011, p. 26, 27). This means that from the point of view of project economics, such scenarios are less favourable. With respect to the presented scenarios, it should therefore be considered that the European Commission has been pursuing an energy policy of ensuring competitive, sustainable and long-term stable energy sources. The scenarios are based on the assumption that the world is facing climate change, which is putting pressure on the relatively low energy demand. The emission credit prices have been set for all scenarios, in order to ensure the highest possible degree of predictability and consequently the lowest possible degree of risk for investors.

[6] Scenario no. 1 is based on a strict energy saving policy until 2050 through the implementation of the Energy Efficiency Plan. The latter stipulates strict requirements regarding the construction of new plants and the renovation of existing ones.

[7] Scenario no. 2 predicts a market competition with disregard to renewable energy sources and energy efficiency, and with acceptance towards nuclear energy. The scenario also projects a strong breakthrough of carbon capture and storage technologies into the market, as well as nuclear energy capture and storage, the latter involving large investments.

[8] The main goal of scenario no. 3 is to increase renewable energy sources in the production of electricity, whereas great emphasis is given to domestic production.

[9] Scenario no. 4 is similar to scenario no. 2, but takes into account problems connected with the construction of facilities for carbon capture and storage. There are also similarities between both scenarios regarding the breakthrough of nuclear power.

[10] The assumptions are similar to the ones in scenario no. 2, whereas the acceptance of the general public towards nuclear power is rather low. The reasons for this lie in the failure to implement technical solutions regarding nuclear waste.

The table below shows the NPV calculations according to the emission credit prices for all five different scenarios and with consideration of two different discount rates. The emission credit costs from the abovementioned scenarios in the first column were calculated at a 7 % discount rate. All other assumptions and input data remain unchanged compared to AIP5. The second column lists the same calculations, but at a 9 % discount rate as stipulated by the sectoral policy for the energy industry. **In both cases, the NPV is negative for all five scenarios.**

Table no. 11: Sensitivity analysis regarding different emission credit prices at two different discount rates

Scenario	NPV considering a 7 % discount rate (million EUR)	NPV considering a 9 % discount rate (million EUR)
Scenario no. 1	-44.707	-179.979
Scenario no. 2	-521.722	-528.038
Scenario no. 3	-379.743	-416.814
Scenario no. 4	-921.458	-778.604
Scenario no. 5	-667.853	-607.539

Source: Own calculations

7. CONCLUSION

Our calculations confirm the correctness of the calculations in AIP5 with the same input data and same assumptions, with depreciation and financing cost not taken into account. It has been established that the mathematical calculation of the economic performance of the investment, taking into account the default values of the input data, was technically correct (the calculation of NPV, the repayment period, and the IRR). If the calculation had taken into account the requirements defined by the sectoral policy for the development of the energy industry in the Republic of Slovenia, which is a minimum discount rate of 9 % for investments in facilities for the production of electric power from fossil fuels, the NPV would become negative, and the project unacceptable.

In terms of the financing cost, it is important to emphasize the impact of the changed structure of financial resources on the interest rate risk associated with the project. Due to a partial transition to a floating interest rate, the financing cost in AIP5 compared to AIP4 is accordingly lower. But at the same time, the risk due to potentially higher future floating interest rates has increased, as the project in AIP5 is far more exposed to interest rate risk than in AIP4 due to a higher share of loans with a floating interest rate in the overall funding structure. In consequence, the actual financing cost of the project throughout its service life can be significantly higher than predicted due to the historically low levels of the 6m Euribor and due to distinctly long-term financing with floating interest rates.

Based on the same input data and assumptions as in AIP5, our calculations confirm that the project is highly sensitive to the price of electricity, as the NPV becomes negative with a decrease of the electricity price by as little as 10 %. Our calculation assumes that the revenue from the sales of electricity decreases by 10 % and adds an analysis with a 9 % discount rate as stipulated by the sectoral policy of the Republic of Slovenia for the energy industry. In case of a lower (7 %) as well as a higher (9 %) discount rate, the NPV becomes negative if the revenue from the sales of electricity decreases by 10 %. This means that the project is not reasonable under such conditions.

The sensitivity analysis shows that the project is less sensitive to the price of coal. At a 10 % increase of the price of coal, the NPV remains positive; however, it becomes negative when the price increases by 20 %. Concern whether the assumptions regarding the prices of coal in AIP5 are realistic should be noted at this point, since the price of coal today (2.56 EUR/GJ) is already 13.78 % higher than the price projected for the beginning of the operation of ŠTPP6. If we consider a 10 % increase of the price of coal and the 9 % discount rate stipulated in the sectoral policy for the energy industry, the project becomes unacceptable. Due to its low calorific value, uneconomical transport, and ŠTPP, the price of lignite from the Velenje Coal Mine is strongly locally conditioned and determined. As ŠTPP and the Velenje Coal Mine share the same owner, there is a danger of mutual attrition, be it to the detriment of the coal mine or to the detriment of ŠTPP. If the purchase price of coal is set too low, this could cause the coal mine to have poor economic results at the expense of ŠTPP. The opposite applies in case the price is set too high. Due to joint ownership, this is a matter of distributing the

benefits and costs between the Velenje Coal Mine and ŠTPP. If we considered ŠTPP and the Velenje Coal Mine as two completely separate business entities, it would be necessary and reasonable to analyse the project of using alternative coal (imported) in greater detail and to analyse the project of renovating Units 4 and 5. AIP5 does not explain the risk that the project is exposed to, due to the fact that it has not concluded a long-term coal supply contract at fixed prices. ŠTPP has indeed upgraded the contract that determined the prices only for the year 2015 with an annex to said contract, which extends the validity of the contract until 2054, but the annex does not clearly define binding prices.

Our calculations confirm that, with the same input data and same assumptions as in AIP5, ŠTPP6 is less sensitive to changes of the price of emission allowances than for example changes of the price of electricity. If the price of CO2 emission credits used in AIP5 increases by 10 %, the NPV decreases but remains positive. At a 20 % increase of the CO2 price, the NPV is negative. Considering a discount rate of 9 %, as stipulated by the sectoral policy for the energy industry in the Republic of Slovenia, an increase of the CO2 emission credit price from AIP5 by 10 % results in a negative NPV, and the project becomes unacceptable. Due to the high level of uncertainty regarding future movement of the price of emission credits and their impact on the variable expenses of the investors, an additional sensitivity analysis of the ŠTPP project to emission credit prices was performed. The fluctuation of CO2 emission credit prices in the future had been summarized according to a European Commission report, based on five scenarios that comply with the EU's long-term goals for the reduction of greenhouse gas emissions. In both cases, with a 7 % as well as a 9 % discount rate, the NPV is strongly negative.

Certain assumptions in AIP5 are too optimistic (CO2 credit prices, improved performance without any substantiation, prices of coal), which displays better project economics, but fails to control overall hazards and risks that the project is exposed to (for example changed interest rates, outstanding long-term coal supply contract at fixed and binding prices). At the same time, AIP5 also ignores the minimum discount rate criterion stipulated in the sectoral policy of the Republic of Slovenia for the energy industry (9 %), at which the NPV of the ŠTPP6 project is negative in each of the abovementioned scenarios.

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