A critical examination of the investment proposals for Unit 6 of the Šoštanj Power Plant

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CEE Bankwatch Network. Bankwatch is an international non-governmental organisation (NGO) with member organisations from countries across central and eastern Europe (CEE). We monitor the activities of international financial institutions which operate in the region and promote environmentally, socially and economically sustainable alternatives to their policies and projects.

Focus Association for Sustainable Development is an independent, non-governmental, apolitical and non-profit environmental organisation. The mission of Focus is to stimulate solutions for environmentally and socially responsible life through education, awareness raising and co-shaping policies in the field of climate change. We focus our work on the issues of climate, energy, mobility, global responsibility and consumption. In the framework of these issues we organise various events, run campaigns and practically oriented projects, raise awareness, monitor, analyse, take part in decision-making processes, co-operate with a variety of stakeholders and work with the media. The work runs at local and national level, as well as at EU and international level.

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Contents

1 Introduction

1.1 Purpose of this study

The Holding Slovenske Elektrarne (HSE), owner of the electricity production unit Termoelektrarna Šoštanj (ŠTPP) in Slovenia, has commissioned a plan to construct Unit 6 of this powerplant. The main reason for the investment in a new Unit 6 is that the existing production units in ŠTPP are obsolete and operating with outdated technology which will eventually fail to comply with the minimum requirements for such units. The proposed Unit 6 will replace Units 4 and 5 and will be fired using lignite from the nearby Velenje mine. Using modern technology, efficiency of electricity production will be enhanced and environmental impacts per produced unit of electricity lowered compared to present electricity production.

In 2005 the first investment plan has been submitted, which has been adapted in 2006 and 2009 to qualify for loans from the European Investment Bank (EIB) and European Bank for Reconstruction and Development (EBRD). In 2011 a fourth revision of the investment plan (IP4 hereafter) has been drafted which was required as the EIB requested a state guarantee. The Slovenian “Decree on the uniform methodology for the preparation and treatment of investment documentation in the field of public finance” (Official Gazette RS, No. 60/2006) requires certain rules to be followed for this state guarantee. One of these specific rules lay in the area of the expected rate of return on investments, which must exceed the 7%. The amended investment plan of 2011 shows that the internal rate of return indeed does exceed the 7%. However, given the high degree of risk of the project, the Slovenian government demanded in April 2011 a minimal discount rate of 9%. This discount rate is accordance with the sectoral policy for the energy sector[1]. This implies that the IRR in the amended investment plan is lower than mentioned in the governmental guideline.

As with any investment plan, the calculations crucially depend on the assumptions that have been included on the future development of costs and benefits. CEE Bankwatch Network and Focus, association for sustainable development, have asked CE Delft to review the investment plan for the Šoštanj lignite fired powerplant and investigate whether crucial variables have been rightly assessed. This report analyses the investment plan and compares the assumptions relating to the future underlying the investment plan.

1.2 Structure of the report

First, in Section 1.3, we will provide some technical background information on the investment initiative at Šoštanj and in Section 1.4 we will summarize the main findings of the financial investment plan. Then, in Chapter 2, we will analyse the main findings with respect to crucial variables in the investment plan, such as electricity prices, CO_2 allowance prices, costs of investment and other aspects. While some of these aspects have properly been included in the investment plan, there are serious doubts about various aspects, in particular coal prices, CO_2 prices and electricity output. Then in Chapter 3 we will assess

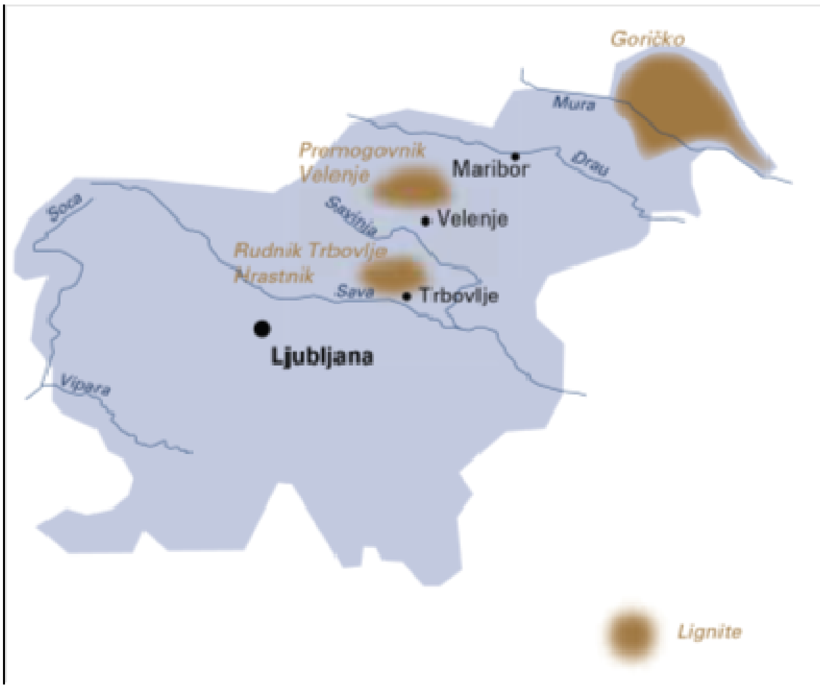
[1] http://www.mg.gov.si/fileadmin/mg.gov.si/pageuploads/Energetika/Dokumenti/Sektorska_politika_Energetika_Final.pdf, p. 46.

the likeliness that taking into account more realistic assumptions on these variables would have yielded different outcomes with respect to the profitability of the project. Finally, Chapter 4 draws conclusions.

1.3 Background information: the investment initiative at Šoštanj

The Termoelektrarna Šoštanj d.o.o. (TEŠ) power company has planned the realisation of a new ultra super critical pulverized lignite fired 545 MWe (net) power station at its production site near Velenje and the Premogovnik Velenje lignite mine (see Figure 1). TEŠ is a thermal generation Company owned by Holding Slovenske Elektrarne d.o.o. (HSE), the largest Slovenian organisation in the area of power generation.

Figure 1 Location of the TSPP site and adjacent lignite reserves



Source: http://www.euracoal.org/pages/layout1sp.php?idpage=80.

According to the non technical summary of October 2009 *"Termoelektrarna Šoštanj d.o.o. is undertaking a modernisation program aimed at meeting Slovenia's future energy demands in compliance with European Union environmental standards."*[2]

The modernisation process is focused on the replacement of existing low efficiency lignite fired units with a new state-of-the art Unit 6, constructed within the boundaries of the existing site. The existing Units have a net efficiency of 32.5% - 33.0%. Units 1 – 4 are to be shut down completely, Unit 5 is to become a cold standby unit (partial load unit) with a maximum production of 1,055 GWhe/year, half of current annual production.

[2] Modernisation and Reconstruction of Termoelektrarna Šoštanj Power Plant, Non-technical summary, October 2009.

Figure 2 **Location and impression of the TSPP site**

Source: http://www.te-Šoštanj.si/filelib/ebrd/nts_final_eng.pdf.

Table 1 **Current power plant inventory**

Power station	Capacity (MWe)	Start data
Unit 1	30	1956
Unit 3	75	1960
Unit 4	275	1972
Unit 5	345	1977
Gas Turbine 1	42	2008
Gas Turbine 2	42	2008

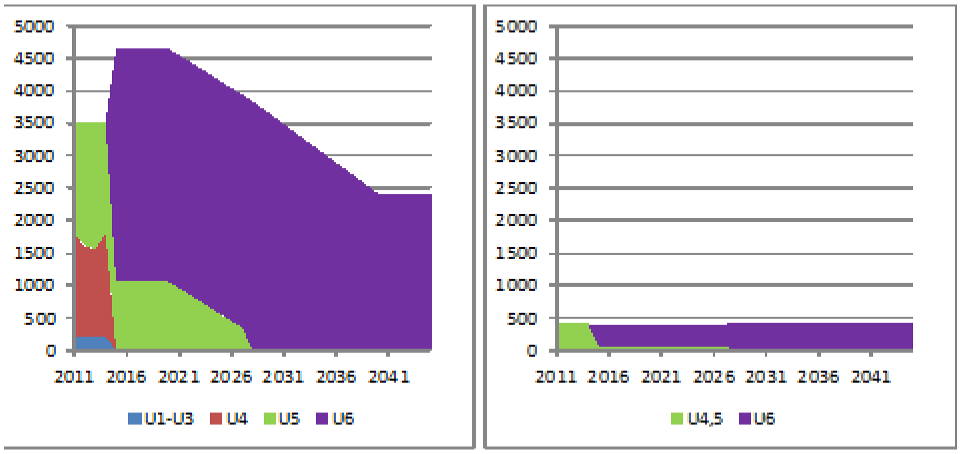
The technical specifications of Unit 6 as given in the 'amended investment plan' of August 2011 are summarized Table 2. The designed changes in power and heat generation of the different units are illustrated Figure 3.

Table 2 **Technical specification of TSPP Unit 6**

Power station	
Power installed (MW_e)	
- gros maximum	600
- net maximum	545
- net annualized average	532
Heat generation, annual average (MW_{th})	50
Net electric efficiency (maximum power generation)	42.6%
Annual operational time (hours)	6,650

As outlined in the fourth investment plan (IP4), TES expects in the first ten years after the start up of Unit 6 to be able to sell approximately 1,000 GWhe/a year more electricity than it currently produces. Heat production remains more or less constant with a small expected increase after 2028.

Figure 3 **Projected changes in power (left figure) and heat generation (right figure) of individual power plants (all figures in GWh/a). Data from the IP4**



The mentioned operational period per year of 6,650 hours between 2015-2028 is somewhat higher compared with current operational hours for unit 4 and 5 (6,000–6,250 hours/a). After 2028 the operational hour slowly decrease implying that unit 6 is less frequently used to satisfy base load and more frequent start-ups are foreseen.

The technical potential of Unit 6 will permit flexible operation, which means that the sales price achieved will be above the base load price. According to the analysis conducted, the sales price would be 6 or 7 % above the base load price. Assuming a downtime of 2 weeks/year for maintenance, the Unit will operate at an average capacity of 80% with a range of ± 20%.

1.4 Background information: the financial investment plan

Investment plans to build the unit 6 for Termoelektrarna Šoštanj in Slovenia have been underway since 2006. The fourth amended investment plan (IP4 hereafter), released in August 2011, is subject for this study. The main financial results of IP4 are presented in Table 3.

Table 3 **Financial results IP4**

Parameter	Value
Investment repayment period	15 years
NPV with a 7% discount rate	83.6 million EUR
IRR	7.59%
Return on equity	13,6%

Source: IP4.

The results indicate an investment repayment period and an internal return of 7.59%. The return on equity is 13.6%. This shows the profit TEŠ can generate in terms of sources provided by its shareholders.

The yearly operating revenues and costs of the project for some years are presented in Table 4.

Table 4 Yearly revenues and expenses of Unit 6 according to the IP4 (in constant prices, in 1,000 EUR)

	2015	2020	2025	2035	2045	2054
Revenue	**271,707.5**	**291,510.7**	**324,302.3**	**331,484.8**	**324,811.1**	**385,396.2**
1 Electrical and thermal power sales	266,207.5	285,655.9	318,067.3	324,403.8	316,755.4	376,334.2
2 Ash and gypsum sales	1,500.0	1,650.7	1,816.6	2,200.0	2,664.3	3,165.5
3 Ancillary services	4,000.0	4,204.0	4,418.5	4,880.8	5,391.4	5,896.5
Expenses	**244,951.5**	**245,843.3**	**249,928.4**	**249,608.0**	**212,921.1**	**266,143.0**
1 Coal	68,982.3	70,724.2	72,510.1	65,078.3	54,725.2	57,237.6
2 Maintenance	3,300.0	6,600.0	6,600.0	5,956.9	6,506.9	6,506.9
3 Depreciation	42,722.5	42,722.5	42,722.5	42,722.5	2,107.2	2,107.2
4 Labour costs	7,100.0	7,462.2	7,842.8	9,024.3	9,569.7	10,466.3
5 Financing costs	41,600.8	27,576.8	16,487.5	2,485.3		
6 Other costs	12,422.1	12,686.9	12,959.0	12,765.2	11,851.7	12,348.8
7 CO_2 emission credits	68,823.8	78,070.6	90,806.4	111,575.4	128,160.5	177,476.3
Profit/Loss	**26,756.0**	**45,667.4**	**74,374.0**	**81,876.6**	**111,890.0**	**119,253.2**
Income tax	5,351.2	9,133.5	14,874.8	16,375.3	22,378.0	23,850.6
Net profit/loss	**21,404.8**	**36,533.9**	**59,499.2**	**65,501.3**	**89,512.0**	**95,402.6**

The table shows that the main revenues are electricity sales. The costs consist mainly of lignite costs, depreciation, financing costs and costs for buying CO_2 credits. The net profit of the project is expected to increase during the lifetime of the project.

2 Analysing financial viability

2.1 Introduction

The investment plan, 4th revision (hereafter IP4), concludes that the investment proposal has a positive internal rate of return of 7.59%. The internal rate of return is a technical measure Alternatively, one could say that the investment will pay back itself in 15 years.

Although the IP states that it adheres to the guidelines on Cost-Benefit Analysis from the EU and to the concept of opportunity costs, this is actually not the case. There are, with the exception of a few highly unrealistic scenarios (labeled as 'illustrative') in the Annex 9 of the IP4, no realistic alternative scenarios formulated which could be an alternative for the construction of the 600 MW powerplant. As alternatives one could imagine the prolongation and subsequent closure of the existing units, investment in renewable energy sources or the placement of a much smaller unit to replace existing production facilities in Units 4 and 5. A recent study by the influential State Umwelt Bundesrat in Germany (SRU, 2011), summarizing the findings of nine recently published studies, concludes that in the EU renewable energy is increasingly becoming a financially attractive alternative for newly built hardcoal and lignite power plants. Between 2032 and 2044, renewable energy will be more cost-effective than hard- and browncoal fired power plants that are constructed now.

Adhering to the principles of Cost-Benefit Analysis is important for justifying input of subsidies or state guarantees in this project. While a private investor may decide to undertake an investment plan without investigating potential alternatives (as it is his own privately owned money), rules for applying to state grants or guarantees are usually much stricter. In this case, the project must provide information that it is beneficial for the society as a whole and this can only be decided if proper alternatives (e.g. likely base-scenarios) have been defined. From a cost-benefit perspective, the IP4 compares investing in the Unit 6 with doing nothing and concludes that investment in Unit 6 is more profitable than doing nothing. But it does not evidence that investment in Unit 6 is the best alternative for the government to participate in the risk of the investment and at the same time securing energy supply in Slovenia. There may be alternatives which are less costly and preferable from a cost-benefit perspective. However, we cannot assess this from the IP4 alone.

With this important caveat in mind, we continue our analysis in the next paragraphs where we will scrutinize the financial information that is in the IP4. First, the stated cost-categories from the IP 4 (reproduced in Table 4 above) will be analyzed in Section 2.2. Subsequently, the estimated benefits in the IP4 will be analyzed in Section 2.3.

2.2 Costs

In our review we have focused on the following cost-categories:
- investment and operational costs;
- lignite consumption;
- lignite costs;
- CO_2 emission credit costs.

2.2.1 Investment and operational costs

According to the amended investment plan version august 2011 the overnight investment costs for the 545 MW_e (net) pulverized lignite power plant will amount to M€ 1,196 or € 2,194 per kW_e installed capacity, including costs for power grid connection and coal supply infrastructure. This value is certainly not too optimistic when compared with values mentioned for investment costs for pulverized lignite power stations in e.g. Germany and the Czech Republic.

Table 5 **Comparison of specific investment costs for Šoštanj TPP supercritical pulverized lignite power stations with investment costs for similar power plants**

Power station	Capacity (MW+)	Net efficiency	Specific investment costs (€/kW+)
Šoštanj TPP unit 6	600	43%	2,194
- USC lignite PCC in Germany	1,050	45%	1,540
- USC lignite PCC in Czech Republic	600	43%	2,440
New RWE PCC plant announced[3]	1,100		1,370
Neurath F and G units	1,030 each	43%	1,070

USC = Ultra Super Critical.

PCC = Pulverized Coal Combustion.

Source information excluding Šoštanj: IEA (2011), Šoštanj information from IP4.

The operational costs for maintenance and supply (or disposal) of by-products and the specific costs for additives utilized in e.g. flue gas cleaning is in line with information mentioned in other sources.

We did not assess in detail the exact financial agreements between the owner of the Šoštanj Thermal Power Plant and Alstom and Siemens for delivering technical equipment, so we cannot assess the question whether there have been hidden costs in these contracts. In case there are hidden costs, the value of investment will be underestimated.

2.3 Lignite consumption

Unit 6 of the ŠTPP will use lignite from the nearby located Premogovnik Velenje (PV) coal mine. The amount of lignite that is being demanded depends on:

a. The amount of electricity produced and the efficiency of electricity production.
b. The amount of heat produced and the efficiency of heat production.

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3 http://www.foxbusiness.com/industries/2011/10/07/rwe-mulls-new-1100mw-lignite-fired-power-plant-in-germany/.

Production in Unit 6 will be 3,529 GWh annually (p138 in IP4[4]) and a production of heat of 352 GW/yr. The amount of coal used for this is being estimated at 2,928 kt/yr (p140 in IP4). Due to technical constraints one would assume that the amount of lignite needed would be more or less constant over the lifetime of the project. There are no updates or retrofitting foreseen in the investment plan, so we assume that the project uses fixed technological coefficients over the lifetime of the project. However, this does not seem to be the case, as the efficiency is fluctuating, actually improving over time. This is not easy to discern as the IP4 does not distinguish in Chapter 13 between production of Unit 6, and Units 4 and 5 between 2015-2028. But from 2028, when only Unit 6 is in operation, one can observe that the efficiency of transformation for electrical power output is actually improving while the transformation for heat is actually constant. Using this constant thermal efficiency for the production of heat, we can recalculate the amount of coal that is being used in Unit 6 for electricity production between 2015-2028. Indeed it shows that the thermal efficiency of the plant is assumed to increase over the lifetime of the project.

Table 6 **Information in the IP4 on coal consumption and electricity and heat outputs. Figures in Italics have been recalculated by us using a fixed coefficient for heat production**

Year		Data given	2015	2020	2025	2030	2035	2040	2045	2050
Electricity produced by Unit 6	A	p138	3,529	3,529	3,529	3,598	2,998	2,399	2,399	2,399
Heat produced in Unit 6	B	p138	352.5	352.5	352.5	432.3	432.3	432.3	432.3	432.3
Coal consumption total	C	p140	2,928	2,928	2,928	2,998	2,498	1,998	1,998	1,998
ow Electricity			*2,822*	*2,822*	*2,822*	2,870	2,370	1,870	1,870	1,870
ow Heat			*105.2*	*105.2*	*105.2*	129.7	129.7	129.7	129.7	129.7
Efficiency coal consumption compared to elec produced			0.80	0.80	0.80	0.80	0.79	0.78	0.78	0.78
Corrected coal consumption for electricity							2,391	1,914	1,914	1,914
In Mln Euros							0.6	1.2	1.3	1.3

However, IP4 does not provide arguments or justifications for this efficiency gain. We cannot imagine any argument why the power plant would becomes more efficient over time. Thermal power plants generally produce less efficiently when output declines. As the output does decline from 2030 and onwards (see Table 6), the implied increase in electric efficiency is contrary to what would be expected during these years. Therefore we conclude that the IP4 contains a mistake in calculating the coal consumed between 2028-2054. This mistake amounts to a 0.6-1.3 million Euros annually between 2028-2054 underestimation of total costs.

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4 All the page numbers of the Investment Plan 4 used in this study were taken from the unofficial translation of the document. It can be obtained on the website of CEE Bankwatch Network http://bankwatch.org/documents/Šoštanj-amendedinvestmentplan-v4.pdf.

Another justification for the sign that some coal consumption has been omitted is the relationship between CO_2 emissions and coal consumption. Using the originally stated coal figures, we see that the CO_2 emissions are declining less pronounced than coal consumption between 2028-2040. Correcting for the coal that was omitted from the financial analysis, the CO_2 emissions are again in line with the corrected figure of coal consumption. Therefore we believe that the coal was erroneously forgotten in making the financial analysis.

In addition to this mistake we want to outline that the IP4 it is not clear whether clear whether the demand for coal from heat generation is included in the total figure of consumption of 2,928 kt/a between 2015-2028, or not. Here we took a conservative approach where we assumed that the stated coal consumption is meant for heat *and* power generation – even if it was not explicitly stated in the tables from the IP4.

2.3.1 Lignite prices

Unit 6 of the ŠTPP will use lignite from the nearby located Premogovnik Velenje (PV) coal mine. Although gas, coal and CO_2 prices are to a certain degree coupled to the electricity price, this is (very often) not the case for the lignite costs. Due to the low calorific value, lignite transport is uneconomic over longer distances. Hence, lignite mines cannot offer their product to far away power stations and there is no free-market price formation for lignite used in power generation. Both producer and consumer co-exist in a captive market and often form a single economic entity.[5] This situation applies for Šoštanj as well, as the owner of PV is the same as the owner of the ŠTPP (p149, investment plan).

The expected lignite price in the IP4 range from € 2.25/GJ in 2015 to € 2.71/GJ in 2054. However, this forecast cannot be compared with widely used and accepted (international) price forecasts such as (coal or gas), as the price is location specific. Therefore, in order to review the correctness of the lignite price, the specific cost price structure of the lignite production in Premogovnik Velenje (PV) has to be analysed.

Cost price calculation Velenje lignite

Some information on the lignite cost price is presented in a study by the IMC-Montan Consulting Group (IMC, 2011), commissioned by the HSE group. In Table 7, the short term cost price forecast (until 2015), in constant 2009 prices, is presented.

Table 7 Price structure of lignite from PV mine

	2010	2011	2012	2013	2014	2015
Material costs	14,763,307	14,788,307	14,464,307	14,241,187	14,018,929	12,492,401
Service costs	37,581,955	36,211,376	35,828,254	35,211,682	34,397,696	31,523,282
Depreciation	14,917,000	15,200,000	15,200,000	14,500,000	14,500,000	13,800,000
Labour costs	52,629,677	49,162,418	48,198,449	47,253,382	46,739,250	45,227,727
Other expenditure	4,481,372	5,081,230	5,480,730	5,058,066	4,928,682	4,589,014
Total expenditure	**124,373,311**	**120,443,332**	**119,171,740**	**116,264,317**	**114,584,557**	**107,632,425**
Coal production in GJ	42,878,000	41,295,000	41,295,000	41,295,000	41,295,000	41,140,000
Cost price EUR/GJ	**2.742**	**2.668**	**2.657**	**2.646**	**2.634**	**2.252**

Source: IMC, 2011

5 http://www.euracoal.org/pages/layout1sp.php?idpage=910.

The table shows that the costs price decreases from € 2.74 per GJ in 2010 to € 2.25 per GJ in 2015. However, this price does not match with the total expenditures and the coal production presented in the table. For instance, if we divide € 124.4 mln total expenditures by 42.8 mln GJ coal production in 2010, this results in a cost price of € 2.90 per GJ instead of € 2.74 per GJ in 2010.

The explanation for this difference is not presented in the table, but is explained in the text of the report. *"In 2010, other income from subsidiary companies amounted to nearly € 7 million but this is planned to increase to some € 15 million in 2015."* Indeed, subtracting this income from the total expenditures results in the presented cost prices for the years 2010 and 2015. However, some serous doubts can be given if such costs should be included in the price calculations. The IP4 does not substantiate how these incomes relate to the production process, and why these incomes should be translated into the lignite price. The authors seem to have doubts relating to this income as well by stating that:

"It is difficult to find any justification for this income and why it varies. Cynically, one might be tempted to infer that this is a 'balancing item' which overall reduces costs to the desired € 2.25/GJ. If this income is not gained, the maximum increase in costs could be as much as € 0.35/GJ. Thus, this income is important to achieving the target cost. However, there is no way to verify plans proposed for current subsidiaries nor how new ventures, set up in order to create more jobs to replace those lost in PV, will perform."

The fact that this statement by IMC is included in the report and not satisfactory refuted, is an other argument that makes this inclusion of income doubtful.

We want to stress here that even if the additional income of subsidiaries would be justified and substantiated, it makes no sense to include these incomes in the lignite price. Only costs that are attributable to the production of lignite, should be included in cost price calculations for the new unit.

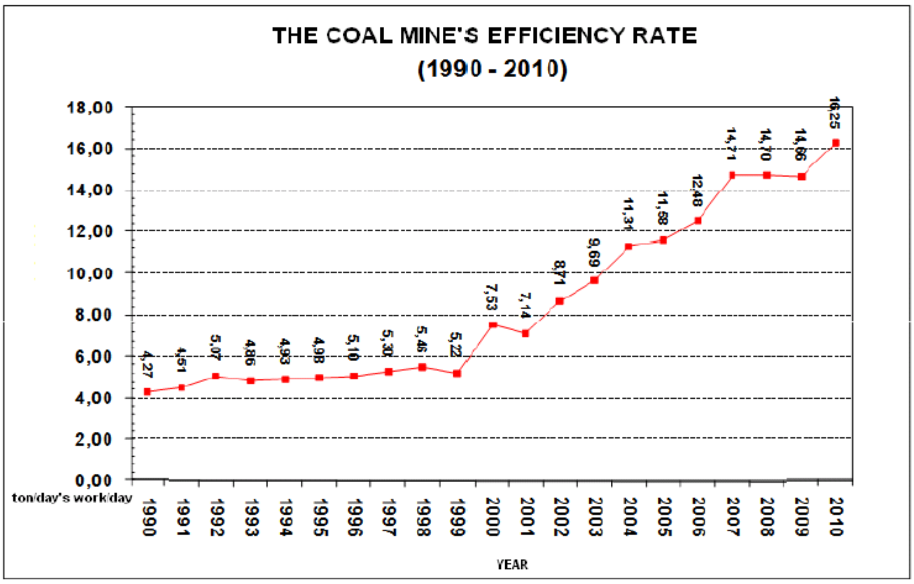
Therefore, in our opinion, this income from subsidiary should not be included in the cost-price calculation as this is a clear example of cross-subsidization neglecting fundamental economic principles of cost-price calculations. Correcting for this mistake would result in a higher cost price of € 2.62 in 2015. This would make annual costs about € 50-70 million higher each year.[6]

Increasing mining efficiency?

The forecast shows furthermore a decrease in material costs, service costs, labour costs and depreciation between 2010 and 2015, while maintaining a more or less constant output (in GJ). The authors state that these predictions *are in general feasible and based upon reliable assumptions.* The efficiency rate of the mine has increased between 1990 and 2010.

6 This impact is not constant throughout the years.

Figure 4 **The coal mine's efficiency rate**



However, the report does not provide detailed information how these cost savings could be achieved. Furthermore, no insight is provided in past cost price developments of the mine related to the efficiency rate. Also no information is provided on autonomous developments of wage levels and other production costs. It is therefore not possible for us to determine to what extent these predictions are reliable and feasible.

The estimated coal reserves in the PV mine would be pretty exhausted over the lifetime of use in Unit 6 (and Unit 5 as a stand-by unit). Normal mine operations may indicate increasing marginal costs of extraction as the mine reaches its end of life. This fact is ignored in the IP4. The IP4 does not substantiate how the efficiency gains would be realized and maintained in the near future. Therefore we classify this as an insufficiently substantiated assumption underlying the cost calculations.

Assuming a more constant efficiency rate, the lignite prices will increase rather than decrease, due to autonomous increase of wage levels and other cost components. This will increase the price of lignite substantially. The impacts of different assumptions with respect to the lignite cost price will be elaborated in Chapter 3.

2.4 Costs for CO_2 emissions

CO_2 emissions are regulated by the EU ETS. When this power plant will be in operation, Phase 3 of the EU ETS is into place in which CO_2 emissions from electricity production will be auctioned.

The CO_2 emissions in Unit 6 are not given directly but can be calculated from the data. There are actually four sources of these CO_2 emissions:
1. CO_2 emissions from electricity production in Unit 6 from coal consumption.
2. CO_2 emissions from heat production in Unit 6 from coal consumption.
3. CO_2 process emissions from the desulphurization equipment in Unit 6.
4. CO_2 emissions from using oil for start-ups.

We notice here that in the cost calculations only the first cost category has been taken into account. The omission of the fourth category is clearly inappropriate as these will fall under the EU ETS already now. However, as the unit uses 1,392 t oil a year, the associated CO_2 emissions would be relatively small, somewhere in the range of 4,400 t CO_2/yr. This is a relatively small amount. Expressed at an estimated emission price of € 22, this would imply that the financial calculus misses almost € 0.1 million annually in CO_2 credits that need to be bought.

However, we would also expect that after 2020 also the second and third category would fall under full auctioning. The Commission has indicated in the EU ETS Directive that free allocation should be regarded as a temporary phenomenon only. Recital 27 of the revised EU ETS Directive (2009/29/EC) states that:

"Member States may deem it necessary to temporarily compensate certain installations which have been determined to be exposed to a significant risk of carbon leakage for costs related to greenhouse gas emissions passed on in electricity prices. Such support should only be granted where it is necessary and proportionate and should ensure that the Community scheme incentives to save energy and to stimulate a shift in demand from 'grey' to 'green' electricity are maintained".

The fact that heat and process emissions are currently left out from auctioning have more to do with the fact that these were largely overlooked during the time of construction of the revised EU ETS Directive as all attention was being focused on the question whether industrial installations should fall under full auctioning during Phase 3 of the EU ETS. Therefore we would find it more logical to assume that these emissions will fall under auctioning after 2020, especially since there has been no carbon-leakage threat identified for power suppliers. Assuming that these emissions would still qualify for free allocation all the way up to 2054 is clearly a methodological mistake neglecting the temporary character of free allocation in the EU ETS.

Correcting for this mistake would mount to a more substantial correction of about 194,153 t CO_2 annually, resulting in additional yearly expenses increasing from € 4.9 to 13.9 mln between 2021 and 2050.

CO_2 prices

CO_2 prices are in the IP4 taken from an analysis by the Jožef Stefan Institute (p71). These price forecast assume a price of € 20 in 2011, slowly increasing to € 24 in 2020. Afterwards price increase by about 3.7% per annum until it reaches € 71 in 2050.

These price forecasts are in principle within the range that other institutes provide. The Impact Assessment from the EU assumes a price of € 17 if the EU stays at the 20% climate target, to € 30 if the EU would move to a -30% target. In SRU (2011), it can be seen from Table 3.2. that various studies predict a global CO_2 price between € 30-70 in 2050. If the EU needs to move ahead of the rest of the world, also by 2050, prices in the EU can be assumed to be higher.

One particular reason why we would expect that the EU would need to move forward to -30% and that a higher price path can be chosen, is that the EU has committed itself to the 2 degrees Celcius requirement as given in the 2050 Low Carbon Roadmap (2011/112/EC). This would effectively imply that the EU would need to reduce its emissions by 80-95% in 2050, which would imply that a target of -30%, or even -40% by 2020 would be in line with this ambition (CE Delft, 2010). Hence, a price path of € 30/t CO_2 in 2020 would have been in line with this ambition. The IP4 assumes that the EU will not step up to -30%. While this may be a legitimate choice given the recent hesitation in the EU to take the leader ship in international climate negotiations, it is a risk for this project. The financial calculus will be much less favourable if the EU would step up to -30%.

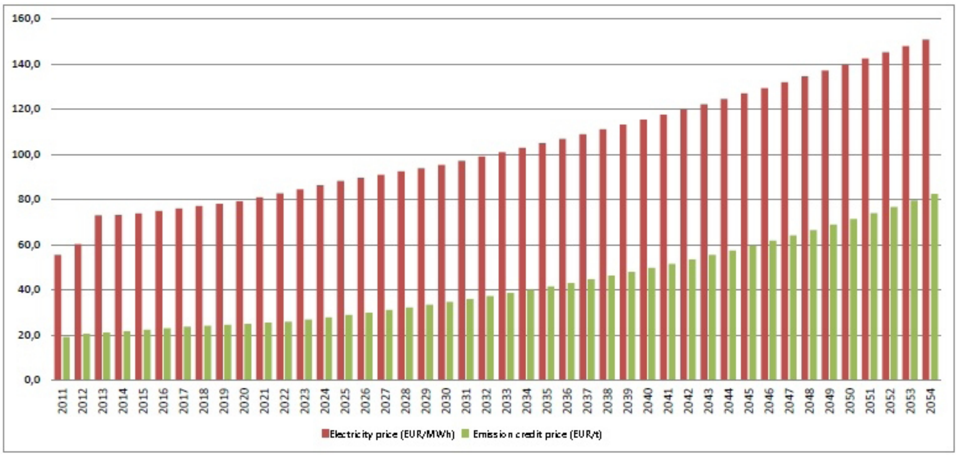
2.5 Benefits

The costs must be compared with the benefits. Benefits are primarily the electricity production. We will investigate here the used electricity prices and the expected electricity production.

2.5.1 Electricity prices

The electricity prices in the investment plan are based upon forecasts by the Jožef Stefan Institute.

Figure 5 Electricity prices investment plan

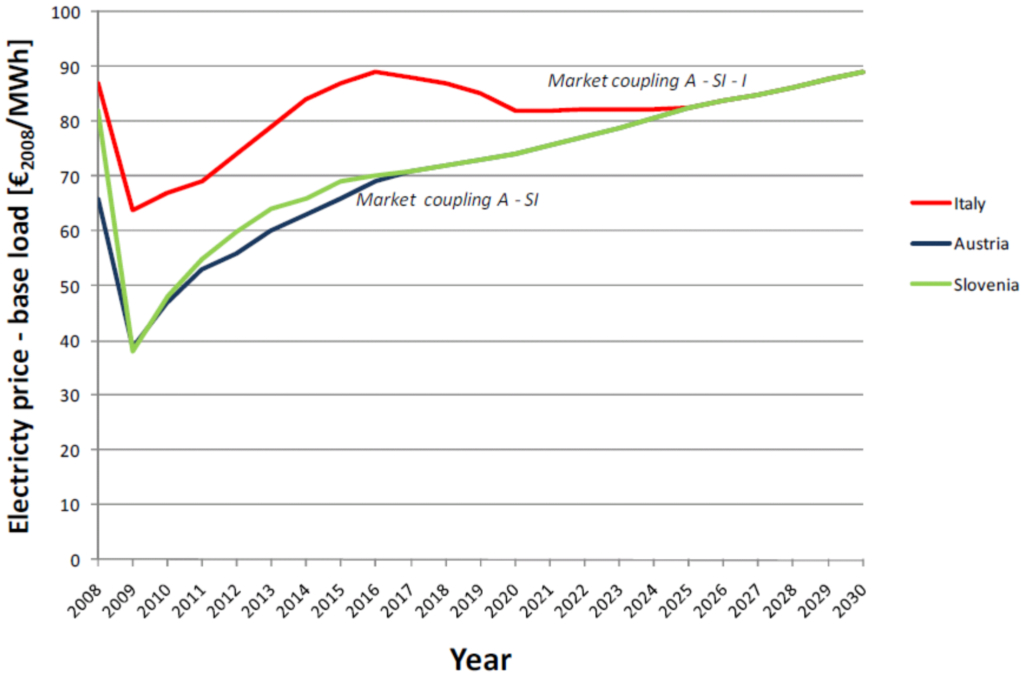


Notes: Source: IP4. *Prices of electricity and prices of emission credits until 2015 have been determined based on 'future' prices on EEX and projections of HSE professional services, and adapted according to the specific operational regime of ŠTPP. The peak/base ratio from the latest available period and an average annual production of 3,600 GWh have been taken into account. Prices of electricity and of emission credits between 2015 and 2030 have been taken from the NEP draft. Prices of electricity and of emission credits between 2030 and 2054 have been projected with the same growth dynamics that are predicted in the NEP draft for 2015-2030.*

Another figure of the Jožef Stefan Institute (2011) shows that price predictions are based on the assumption that the Slovenian market will be integrated with Austria around 2020 and around 2025, the Slovenian, Austrian and Italian market will be coupled (see Figure 6). In this integrated market, the base load electricity market price will be close to the level of expected production costs of new gas fired power plants.

This figure differs to some extent from the price forecast used in the investment plan, although in general the trend is comparable. For instance, the 2030 price is € 90 per MWh, while the price in the investment plan is € 95 per MWh. This difference can be explained by the fact that Figure 6 shows the base load electricity price, while the electricity price in the investment plan is based on a mix of base load and peak load prices. Therefore we agree that the price estimate taken from the IP4 is in line with the estimates from the Jožef Stefan Institute.

Figure 6 **Development of electricity price on the regional market**



Source: Jožef Stefan Institute, 2011.

These price forecasts are more or less in line with gas price projections performed for the Austrian climate strategy[7] (WIFO, 2011). Austrian scenarios show that the relative price of gas to oil is predicted to be a constant factor of 0.8 while the oil price development shows more or less the same trend as the electricity price predictions in Figure 6. Furthermore, the electricity price forecasts for Austrian households, roughly doubling between 2009 and 2030, are more or less in line with price predictions in Figure 5 and Figure 6.

We therefore have no major comments on the electricity prices in the document.

2.5.2 Electricity production and operation hours

The Šoštanj TPP Unit 6 is anticipated to produce 3,500 GWhe/a, equivalent to an availability of 6,650 equivalent hours per year of full load production.

The closure of Units 1 to 4 and the reduction of production by Unit 5 will leave a gap of approximately 2,500 MWhe.
Next to this Unit 6 is expected to substitute part - approximately 1,000 GWhe - of Slovenia's power import.

7 These projections have been carried out for a study providing energy scenarios for the Austrian economy up to the year 2030. These scenarios are developed as information basis for deriving corresponding greenhouse gas (GHG) emissions trajectories. These are a prerequisite to fulfil the reporting requirements according to the Monitoring Mechanism 2011 and to the United Nations Framework Convention on Climate Change (UNFCCC) as well as for the Austrian climate strategy 2020.

The net import amounted to 1,700–3,000 GWhe in in the economically prosperous but climatologically dry period from 2003 to 2008 and increased year after year because of increasing power consumption at stagnant power generation levels.
The balance improved in 2009, with power imports declining to zero. This was mostly due to decreased economic activity and, consequentially, decreased energy consumption caused by the world financial and economic crisis. The improvement of the energy balance in 2009 can be attributed to, on the one hand, significantly lower consumption of large direct consumers, and on the other hand, favourable hydrology in that year and the consequential above average production of electricity in hydroelectric power plants.

Consumption has gone up slightly in 2010 and TES estimates that the trend will continue in the coming years along with the gradual recovery of the economy.

However, the initiator expects that even if the economic crisis continues and hydrological situation remains favourable for hydroelectric power generation there is still enough room for the extra 1,000 GWhe/a of power produced by Unit 6, as the surrounding countries also seem to have a negative electricity balance and as Slovenia has a good interconnection capacity with Austria, Italy and Croatia.

Clearly if this expectation proves erroneous and TSPP cannot market the extra 1,000 GWhe, this will significantly influence plant profitability as it means a reduction in power sales of more than 25% compared with anticipated marketable volumes. The economic conditions for the future are very uncertain and this may impact on demand, at least in some years, as it did in 2009.

This risk has not been considered in the risk assessment, perhaps because the initiator considers a lower than anticipated demand for electricity as an unlikely risk. However we think that this is a substantial risk in the project and it should have been included. The fact that the IP4 assumes that the demand for electricity will remain high and the Unit can successfully compete in the regional power market is insufficiently substantiated in the IP4. Therefore we will include, in Chapter 3, a scenario where this risk will be taken into account.

2.5.3 Other benefits

The unit produces additional benefits, such as gypsum from fly-ashes that are very small compared to the benefits from electricity production. There is no reason to assume that the estimated values will be different.

2.6 Conclusion

In this chapter we have scrutinized the financial information that is in the IP4. When analyzing the financial parameters, doubts have risen related to the following issues:

Methodological mistakes

1. Lignite prices are too low (income of subsidiary companies should not be included).
2. The lignite consumption in Unit 6 is too low from 2028 and on as the IP assumes that efficiency in electricity production between 2028-2054 is improving, while a constant efficiency is more likely.
3. In the calculation of the CO_2 costs, the oil consumption has not been taken into account and the IP4 incorrectly assumes that emissions for heat generation and process emissions from the desulpherisation unit will receive free allocation until 2054. Instead we assume that these emissions will fall under auctioning from 2020 and on.
4. *Unsubstantiated claims.*
5. The increase of mine efficiency is not substantiated (resulting in underestimation lignite prices).
6. The market for extra electric power output is not substantiated (1,000 GWh).

In the Chapter 3 we present the impact on the IRR when we make adjustments for these assumptions.

In addition to these we have found mistakes in the following areas:

- The IP4 does not adhere to principles of Cost-Benefit Analysis as no realistic alternatives for the investment have been formulated.
- The risk for the project if the EU would step up to a -30% climate target have not been addressed properly in the IP4. The investment plan assumes that the EU will not decide upon more stringent climate targets and this is a risk for the project not well considered in the IP4.

3 Impacts on profitability

3.1 Introduction

Chapter 2 has revealed a number of weaknesses in the assumptions, prices and calculations in the amended investment plan. We have differentiated between methodological mistakes that have been made in the correction of the costs, and the unsubstantiated assumptions that would pose a risk to the project. In this chapter, we will determine the impact on the Internal Rate of Return, when adjustments are included. We have determined the impact for five different scenarios.

3.1.1 Scenarios

The scenarios are presented in Table 8. We start with a scenario with one adjustment. In the following scenario's we add extra adjustment, resulting in a lower IRR for the next scenario as adjustments are added cumulatively.

Table 8 **Scenarios for analysing profitability**

Scenario	Content
1. IP4	The same as in the IP4
2. Correct methods	Correction for the methodological mistakes concerning efficiency of electricity generation, lignite prices and included CO_2 categories
3. Correct methods + higher lignite prices	Correction for the methodological mistakes and the scenario where efficiency gains in mine operation would not materialize
4. Correct methods + constant operation hours	Correction for the methodological mistakes and the scenario where output of the electricity unit is not increased (operation hours are 5,650 hours/year instead of 6,650 hours)
5. Worst case scenario	Scenario that combines 3 and 4

So the first scenario is to try to reproduce the results from the IP4. The second scenario corrects for the methodological mistakes that have been identified in Chapter 2. The third scenario adds to this an adjustment for lignite prices assuming a constant efficiency rate, this will lead to a higher lignite price then only correcting for income of subsidiary companies. The fourth scenario assumes the methodological correction and the situation where the unsubstantiated increase in electricity sales do not fully materialize and operation hours stay 15% below the IP4 (so that the operation hours are similar to the present units). Finally, in the fifth scenario, we combine the elements in the third and fourth scenario so that both unsubstantiated claims (the efficiency increase in lignite mining and the additional sales of electricity) do not materialize.

3.1.2 IRR calculation

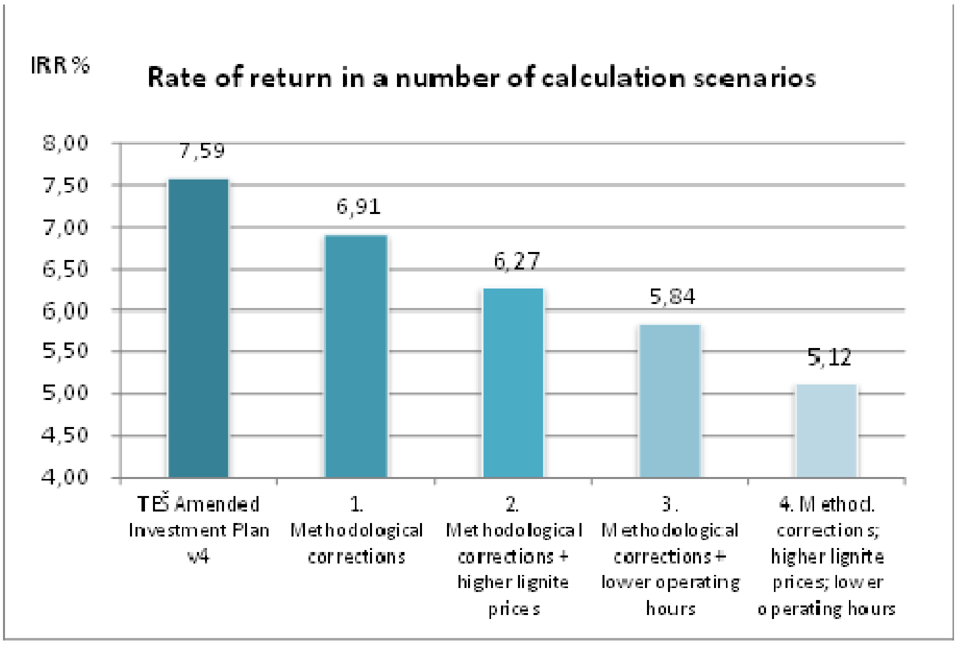
The IRR of the different scenario's have been calculated using the cash flows of annex 3 of the IP4 as a basis. The IRR implies that costs and benefits (negative and positive cash flows), should be discounted with an internal rate of return that yields a net present value which is zero. The following formula has been used to calculate the IRR.

$$\mathrm{NPV} = \sum_{n=0}^{N} \frac{C_n}{(1+r)^n} = 0$$

In this formula Cn are the cash flows in year n and r is the internal rate of return.

Filling this formula with the cash flows, shows indeed that the IRR of the investment plan equals to 7.59%. This number seems to be calculated correctly in the IP4. However, correcting for the methodological mistakes and unsubstantiated claims reduces the IRR considerably. This can be seen in Figure 7.

Figure 7 Rate of return from the scenario analysis



Source: Own calculations.

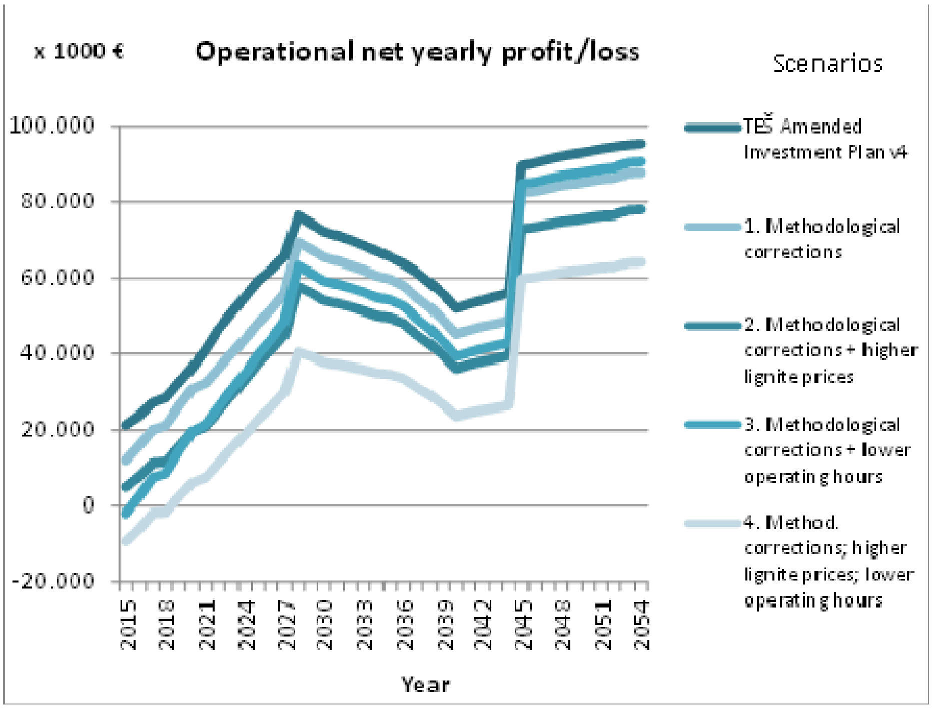
The analysis shows correcting the IP4 for the observed methodological mistakes, lowers the IRR to 6.91%. This is below the threshold value of 7% required by the law and even further from 9% that was requested by the Slovenian government in April 2011. In scenario 2, the IRR drops to 6.27%. It shows that the viability of the plan very crucially hinges on the assumed increase in mining efficiency. Alternatively, if one would assume that the produced electricity will be in lower demand than predicted in the IP4, the IRR would drop to 5.84% - an even more significant decrease. The fifth scenario, assuming that both the efficiency gains in mining and the targeted increase in sales of electricity will fail, would make the IRR to drop nearby the 5%.

3.2 Impacts on net operating profits and losses

The methodological corrections and the removal of unsubstantiated claims in the IP4, makes the additional unit 6 also less profitable.

A graphical picture of the total net yearly profit/loss of the scenarios is given in Figure 8.

Figure 8 Operational net yearly profit/loss



This figure shows that the profitability of the plant will decrease quite substantially. However, as expected from the positive IRR, the investment remains profitable for the company, as the net gains are in all scenarios outweighting the net losses.

3.3 Conclusions

In this chapter we have determined the impacts for adjusting for factors revealed in Chapter 2. In Chapter 2 we have identified a couple of methodological errors, and, in addition, a few unsubstantiated claims. The results from our IRR analysis show that correcting for the methodological mistakes lowers the IRR from 7.59% to 6.91%. The unsubstantiated assumptions in the IP4 give room for more risks. If all risks would materialize, the IRR would drop to nearby 5%. The operational profit and losses are, on average, about half of what is expected in the IRR.

4 Conclusions

The Holding Slovenske Elektrarne (HSE), owner of the electricity production unit Termoelektrarna Šoštanj (ŠTPP) in Slovenia, has commissioned a plan to construct Unit 6 of this powerplant. The main reason for the investment in the new Unit 6 is that the existing production units in ŠTPP are obsolete and operating with outdated technology which will eventually fail to comply with the minimum requirements for such units. The proposed Unit 6 will replace Units 4 and 5 and will be fired using lignite from the nearby Velenje mine.

Between 2005 and 2011, four investment plans have been produced with quite a lot differences in calculations and outcomes. CEE Bankwatch Network and Focus, association for sustainable development have asked CE Delft to investigate the last Investment Plan 4 (IP4). This IP4 concludes that the investment proposal has a positive internal rate of return of 7.59%. However, our methodological review has illustrated a number of shortcomings. We classified them in methodological mistakes and unsubstantiated claims – and they can be summarized as follows.

Methodological mistakes
1. Lignite prices are too low (income of subsidiary companies should not be included).
2. The lignite consumption in Unit 6 is too low from 2028 and on as the IP assumes that efficiency in electricity production between 2028-2054 is improving, while a constant efficiency is more likely.
3. In the calculation of the CO_2 costs, the oil consumption has not been taken into account and the IP4 incorrectly assumes that emission from heat generation and process emissions from the desulpherisation unit will receive free allocation until 2054. Instead we assumed in our financial analysis that these emissions will fall under auctioning from 2020 and on.
4. *Unsubstantiated claims.*
5. The increase of mine efficiency is not substantiated (resulting in underestimation lignite prices).
6. The market for extra electric power output is not substantiated (1,000 GWh).

In addition to these mistakes and unsubstantiated claims a couple of other issues have been identified, such as an incomplete cost-benefit analysis framework of analysis; implicit assumptions that the EU will not step up to a -30% climate target, and vagueness about the inclusion of coal consumption for heat generation between 2015-2028. However, the impacts from these points have not been elaborated further in our report.

The results from our IRR analysis show that correcting for the methodological mistakes lowers the IRR from 7.59% to 6.91%. The unsubstantiated assumptions in the IP4 give room for more risks. If all risks would materialize, the IRR would drop to nearby 5%. The operational profit and losses are, on average, about half of what is expected in the IRR.

The IRR corrected for methodological mistakes is below the threshold value of 7% aimed for by TEŠ and well below 9% that was requested by the Slovenian government in April 2011, therefore under Slovenian conditions this project should not be granted the state support in the form of state guarantee.

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