PROFITABILITY AND DISPATCH OF MPP3 POWER PLANT IN CASE OF BIOMASS CONVERSION

A short report for Uniper Benelux

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EXECUTIVE SUMMARY

On behalf of Uniper Benelux, Frontier Economics has analysed the economic viability of fully converting the MPP3 power plant into a biomass power plant in 2030. The analysis is based on the market framework and power market assumptions used for the Frontier Economics studies on the impact of a carbon price floor for the Ministry of Economic Affairs & Climate and Energie-Nederland in 2018.[1]

The overall conclusion is that the biomass conversion in 2030 is not a profitable investment. The details of the conclusion are summarised as following:

Financial indicators

- The conversion of MPP3 into a biomass power plant in 2030 is not profitable in the scenario given. The Net Present Value (NPV)[2] of the investment is -123 mn. EUR (real, 2017).
- This result is driven by negative EBITDA in the first ten years after the conversion. According to our analyses, EBITDA turns positive for MPP3 in 2042. While investments in power plants normally benefit from high returns in the period after the investment, this is not the case for the biomass conversion case discussed here. This adds additional financial risk to the investment required for the conversion in 2030.
- Given the coal ban which will effect MPP3 from 2030 onwards, the economic decision would rather be to close the plant than to convert it into a biomass plant in 2030.

Electricity generation

- Electricity generation of the biomass power plant is driven by the fuel costs of the plant and the electricity wholesale price. Due to higher fuel costs caused by firing biomass, electricity generation between 2031 and 2050 will be significantly lower than with coal firing today. On average, we expect the power plant to generate ca. 1.7 TWh per year which is equivalent to an average utilisation of 20%.
- Electricity generation and utilisation are especially low in the first 10 years after the conversion. Between 2031 and 2040 the average electricity generation is expected to be 0.5 TWh per year. This corresponds to a utilisation of 5% to 6%.
- Electricity generation and utilisation improves gradually after 2040 but still remains relatively low: Between 2041 and 2050 average electricity generation is estimated to amount to 2.9 TWh per year. This corresponds to a utilisation of 34% to 35%.

1 Frontier Economics (2018): "Research on the effects of the minimum CO_2 price".

2 The NPV is calculated for the year 2030 and an interest rate of 5.2 % (real)

Operating hours

- The generated electricity develops in line with the operating hours. On average the converted power plant operates 2200 hours per year.
- The operating hours are particularly low in the period from 2031 to 2040 where the plant is expected to operate on average 630 hours per year and perform 8 starts per year.
- Between 2041 and 2050, the operating hours increase to an average of 3,760 hours per year, while the plant performs an average of 29 starts per year.

1 BACKGROUND AND AIM OF THIS STUDY

Background of this study

The Netherlands have committed itself to reaching the ambitious climate goals and to implement the agreements made at the 2015 climate conference in Paris. Within this framework, the Dutch Climate Agreement represents an irreversible step towards achieving a low carbon energy system in 2050.

The coalition agreement of the Rutte III government[3] sets out a medium-term emission target for 2030 and includes additional policy measures for this transformation. In this context, the Dutch parliament has passed a bill that prohibits the use of coal for power generation from 2030 onwards. This would also effect Uniper's MPP3 power plant. The bill does not foresee any general compensation to owners of the plants. The Minister argues that these plants have plenty of alternative fuel sources to which they can convert. Although this may be possible from a technical perspective, such a conversion to alternative fuels requires additional investments in the respective power stations and the economic viability as well as the commercial viability of using alternative fuels (with different variable costs and conversion efficiencies) has to be assessed. The bill is currently being discussed in the Senate.

Aim of this study

In this context Uniper Benelux has asked Frontier Economics to conduct a study in order to analyse the future dispatch, revenues and costs of burning biomass in the MPP3 power plant. The study aims at providing an answer to the question whether converting MPP3 into a biomass power plant might be a commercially viable investment option. As the bill aims to prohibit the use of coal from 2030 onwards, we analyse the effects of converting the power plant in 2030 and its commercial and dispatch effects in the years thereafter.

Structure of this report

This report is structured as follows:

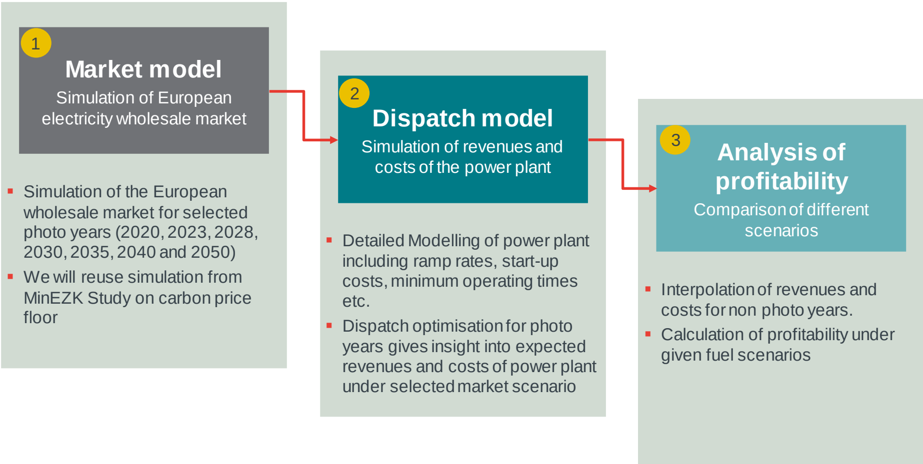
- in section 2, we briefly describe the approach used for the analysis; and
- in section 3, we take a closer look at the commercial viability of converting MPP3 into a biomass plant in 2030.

[3] 2017–2021 Coalition Agreement, VVD, CDA, D66, CU: Confidence in the Future.

2 APPROACH USED TO EVALUATE THE ECONOMIC VIABILITY OF CONVERTING MPP3 INTO A BIOMASS PLANT

In order to analyse the option of converting MPP3 into a biomass power plant in 2030, we use a three step approach consisting of market modelling, dispatch modelling and profitability analysis. The three steps of the analysis are illustrated in Figure 1 and are explained in more detail below.

Figure 1 Three step approach of the analysis



Source: Frontier Economics

Market model

The market model simulates the future investments and divestments into power plants in the European wholesale market for electricity. Based on the modelling, future wholesale prices for selected photo years are derived.[4] The market model takes various assumptions into account, such as future electricity demand, growth in renewable power generation, commodity prices such as coal and gas, the EU ETS price for carbon emissions and different policy measures.

For the analysis underlying this report, we rely on the recent market modelling done for the Ministry and Energie-Nederland by Frontier Economics (2018) in context of the analysis of a carbon price floor. To be more specific, we have used the wholesale prices derived in the "coal ban" scenario, which reflects the market conditions that prevail if the use of coal is prohibited for the generation of electricity in the Netherlands. Though the results of this simulation, undertaken about one year ago, do not reflect the latest changes in commodity prices, carbon prices and policy measures, it allows to build the analysis on a market framework, that was generally accepted by the Ministry, the plant operators and other stakeholders.

Dispatch model

In the second stage of the analysis, we model the power plant in more detail in order to reflect the technical characteristics of MPP3 as a biomass power plant

[4] In line with the study for MinEZK, for this report we have looked at the years 2030, 2035, 2040 and 2050.

more accurately than this can be done in the market model.[5] The detailed mathematical model of MPP3 and the expected wholesale prices from the market model allow the simulation of the future dispatch of the power plant for the photo years of the market model. In the simulation, the profit of the power plant as a price taker is optimised. Based on the plant dispatch, we estimate the revenues and costs which are associated with the operation of the power plant with biomass.

The key assumptions for modelling MPP3 were provided by Uniper Benelux and are shown in Table 1. Note that all financial figures are expressed in real terms in EUR (2017). Because of the lower heating value of biomass compared to coal, converting MPP3 into a full biomass plant will result in a reduced net generation capacity (952 MW instead of 1070 MW) and efficiency rate (44% instead of 45%-46%). We furthermore assume, that the plant is not in operation in the year of conversion (2030).

In addition to the power plant parameters stated in the table, the dispatch optimisation takes the hourly wholesale electricity prices of the “coal ban” scenario and the price of biomass (wood pellets) into account, which were used in the Frontier Economics (2018) studies for the Ministry and Energie-Nederland.[6]

Table 1 Summary of key parameters used to model MPP3 as a biomass plant

Parameter	Value	
Net generation capacity	952	MW
Efficiency at maximum capacity*	44	%
Fix operating & maintenance cost	37.5	mn. EUR (real 2017)
Cost of conversion to biomass	200	mn. EUR (real 2017)
Availability	84	%
Year of decommissioning**	2056	

Source: Frontier Economics based on data provided by Uniper Benelux

*Note: Additional plant parameters used include, min. generation capacity, ramp rate, efficiency at min. load, operational restrictions such as min. operating times and min. down times, energy required for starts, wear and tear costs of starts and other variable costs associated with the use of ammonia and limestone. *Note that efficiency rate is rounded for confidentiality. **Year of decommissioning based on 40 year lifetime. no residual value or decommissioning costs taken into account.*

Analysis of profitability

The profitability of the investment into biomass conversion is calculated on the basis of discounted EBITDA (NPV) of the power plant from 2030 to 2056, i.e. the end of the technical lifetime of MPP3. This means that revenues and costs of the power plant in the time period are discounted and aggregated to the year 2030. For discounting, we use a rate of 5.2% (real).[7] The investment is profitable if the NPV of capital expenditure (capex) and the earnings before interests, taxes, depreciation and amortisation (EBITDA) in 2030 is positive.

[5] For computational reasons, the market model requires the use of a simplified representation of the power plants.

[6] The price for biomass used in the Frontier Economics (2018) study is 32.31 EUR (2017) / MWh including the transport and handling costs of the biomass wood pellets

[7] The cost of capital is expressed as a vanilla WACC and has been derived by ignoring the effects of the tax shield on the 4.8% post-tax WACC used by ECN (2017) in the calculation of base tariffs for the 2017 SDE+ scheme for “Bestaande capaciteit voor meestook” and “Bestaande capaciteit voor bijstook”.

For the years which are not modelled as photo years, we derive the annual dispatch and financial parameters through linear interpolation between the photo years. As 2050 is the last modelled year, we derive annual figures for the profitability post 2050 and until 2056 by continuing the trend between 2040 and 2050 until 2056. However, as it is unclear how margins and operating hours will change, we refrain to estimate dispatch figures for the time after 2050.

3 ECONOMIC VIABILITY OF CONVERTING MPP3 TO A BIOMASS POWER PLANT

The annual time series of revenues and costs of MPP3 allow us to draw conclusions on the commercial viability of converting MPP3 into a biomass plant in 2030. The results from the dispatch modelling of MPP3 as a biomass power plant are summarised in Table 2. The key results are:

- Conversion of MPP3 in 2030 into a biomass plant will have a negative return on investment (NPV of -123 mn. EUR (real 2017)). From a commercial perspective, the power plant would rather be closed (or mothballed) than converted into a biomass plant in 2030.
- The margins following the investment indicate that following the conversion, the power plant will not generate positive EBITDA for the first 11 years. In the scenario given, the biomass plant can be expected to generate sufficient revenues to generate positive EBITDA from 2042 onwards.
- The converted power plant will not exceed 50% utilisation before 2050 and stay below 11% utilisation until 2040.[8]

Table 2 Key indicators of the investment (2030-2056)

Indicator	Value	
NPV (2030, 5.2%)	-123	mn. EUR (real 2017)
Average Utilisation (2031-2050)	20	%
Average operating hours (2031-2050)	2,200	hours per year

Source: Frontier Economics

Overall, we conclude that converting MPP3 into a biomass plant in 2030 is not a viable investment case. In addition, the investment is associated with additional risks, which are caused by:

- the volatile biomass price, which would need to be secured over 20 years at additional costs which are currently not considered in the analysis; and
- the negative EBITDA in the first 11 years after the conversion which requires extremely favourable market conditions in the long run in order to yield a positive return on the investment.

The results from the dispatch modelling of MPP3 as a biomass power plant are illustrated in Figure 2 and Figure 3 below. In the following, we will discuss the background and implications of the results in more detail.

[8] Utilisation is measured as the share of the maximum possible electricity generation reached in a year.

Conversion of MPP3 into a biomass plant expected to have a negative return on investment in the scenario analysed

Figure 2 illustrates capex and EBITDA associated with converting MPP3 into a biomass plant. We assume that the investment to fully convert MPP3 into a biomass plant will take place in year 2030 and requires the plant to be closed for one year. The development of the EBITDA over time can be described as follows:

- **2031-2040:** In the years following the conversion, revenues are low, resulting in a negative EBITDA. The development between 2031 and 2040 can be explained by:
  - the relatively high fuel costs of biomass of about 73 EUR (2017) / MWh; and
  - the moderate average electricity wholesale prices of 51 EUR (2017) / MWh in 2030 to 60 EUR (2017) / MWh in 2040.

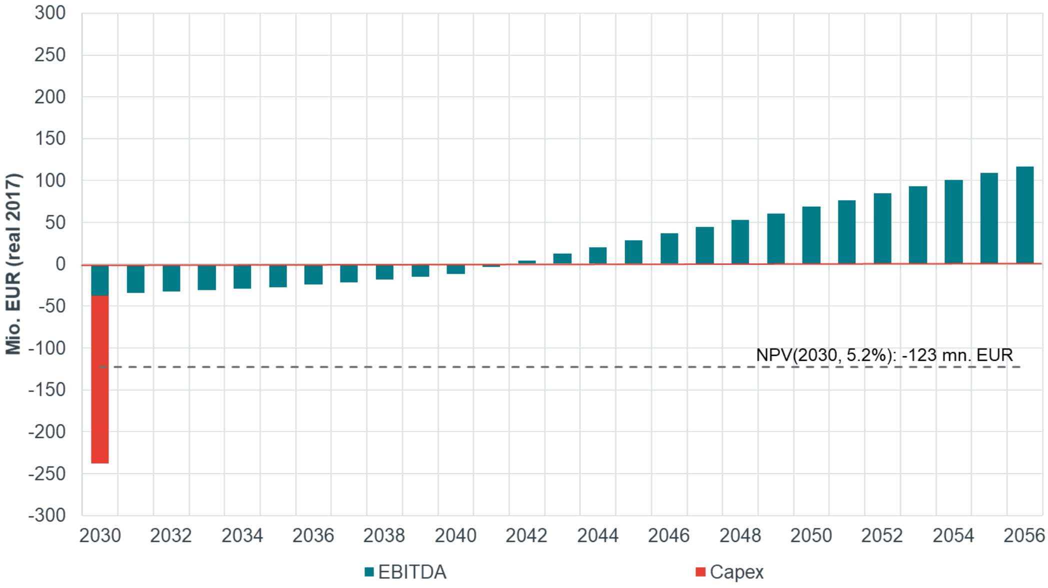
  The combination of both factors results in a limited number of running hours, i.e. a very low utilisation and low operating margins, while at the same time the power plant still incurs (fixed) costs for staff and maintenance work.
- **2041-2050:** After 2040, utilisation and revenues increase in line with the average wholesale electricity prices from 60 EUR (2017) / MWh in 2040 to 70 EUR (2017) / MWh in 2050. Based on this, we expect the EBITDA to turn positive in 2042.
- **Post 2050:** For the time after 2050, we assume that the operating profit will gradually increase in line with the trend between 2040 and 2050. We note that this is an optimistic assumption.

The analysis reveals that converting MPP3 into a biomass plant will have a negative return on investment in the scenario analysed. The NPV (2030, 5.2%) indicates a **negative return of -123 mn. EUR (2017)**. The calculation of the NPV is based on a Weighted Average Cost of Capital (WACC)[9] of 5.2%

[9] The Weighted Cost of Capital (WACC), here called vanilla WACC, is the weighted average of cost of debt and the cost of equity. A vanilla WACC is the weighted average of the pre-tax cost of debt and the post-tax cost of equity.

The WACC is derived on the basis of a typical WACC for biomass cofiring under the SDE+ scheme which is due to the subsidies less risky than the investment in the fuel conversion of a power plant which is not subject to subsidies. As the figure used by ECN is a post-tax WACC, but our analysis is calculating pre-tax margins, the WACC needs to be adjusted to a pre-tax or vanilla WACC.

Figure 2 Revenues and costs of the MPP3 biomass plant



Source: Frontier Economics

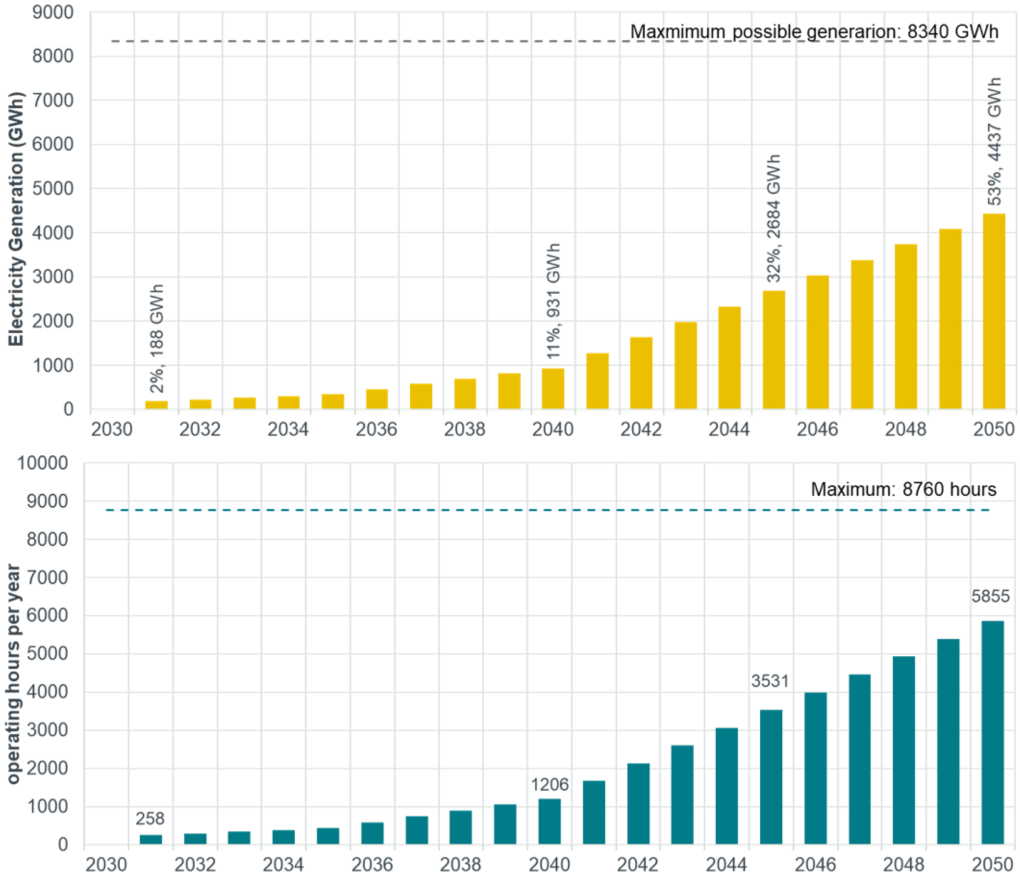
Converted power plant will not exceed 50% utilisation before 2050

Figure 3 shows the annual electricity generation and the operating hours of the converted power plant after 2030. The annual development of the electricity generation and the operating hours are in line with the development of the EBITDA described earlier. The development of the electricity generation and the operating hours is described as follows:

- **2031-2040:** After the conversion, electricity generation and operating hours of the plant are very low until 2040. Between 2031 and 2040 the average electricity generation is expected to be 0.5 TWh per year. The electricity generation of the converted power plant corresponds with:
  - an annual utilisation between 2% in 2031 and 11% in 2040; or
  - operating hours between ca. 260 hours in 2031 and ca. 1,200 hours per year.
- **2041-2050:** Between 2041 and 2050, we expect an increase in the electricity wholesale price relative to the price of biomass. As a consequence, electricity generation and utilisation of MPP3 increases over time. In 2050, we expect the power plant to generate about 4.4 TWh of electricity and exceed a utilisation of 50%. Operating hours increase in line with the electricity generation to ca. 5,860 hours per year.

Overall, converting the power plant to biomass in 2030 will result in a low electricity generation, utilisation and operating hours between 2030 and 2050. In total, we expect the plant to generate about 33 TWh over the 20 years after the conversion.

Figure 3 Electricity generation and operating hours



Source: Frontier Economics

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ANNEX A DATA TABLES

Fuel prices used for the market modelling and the resulting wholesale electricity price in the Netherlands are shown in Table 3. The results from the dispatch model are shown in Table 4.

Table 3 Electricity, fuel and CO_2 prices

		2020	2023	2025	2030	2035	2040	2050
Coal	EUR (2017) / MWh(th)	9.01	9.43	10.30	11.30	11.97	12.46	13.24
Gas	EUR (2017) / MWh(th)	18.34	20.30	22.97	25.88	28.23	30.29	34.36
Oil	EUR (2017) / MWh(th)	32.13	38.95	47.39	53.68	58.82	63.38	72.52
Biomass	EUR (2017) / MWh(th)	32.3	32.3	32.3	32.3	32.3	32.3	32.3
CO_2 Price	EUR (2017) / t	12.50	14.34	17.42	25.12	32.82	40.52	80.03
Electricity	EUR (2017) / MWh	45.4	41.7	45.0	50.8	54.8	59.9	70.0

Source: Frontier Economics

Note: Price for biomass includes transport costs. Other commodity prices are exclusive of transport costs.

Table 4 MPP3 dispatch model results

		2020	2023	2025	2030	2035	2040	2050
Electricity Generation	GWh	-	-	-	0	349	931	4,437
Utilisation	%	-	-	-	0%	4%	11%	53%
Operating hours	h/a	-	-	-	0	441	1,206	5,855
EBITDA	mn. EUR (2017)	-	-	-	-35.7	-25.9	-6.5	89.1

Source: Frontier Economics

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