



## The Economic Viability of Nuclear Power in The Netherlands

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# The Economic Viability of Nuclear Power in The Netherlands

**Delta has announced plans for a nuclear power plant...**

**...which has caused a public debate on nuclear power in The Netherlands.**

**This report assesses the economic viability of new build nuclear power plants in The Netherlands**

**Background and Introduction** – Utility Company Delta recently announced it has started the permitting procedure to build a new nuclear power plant in the Netherlands. Delta is one of the smaller Dutch utility companies, and is the joint owner and operator of The Netherlands' only operational nuclear power plant in Borssele. This plant was built in the mid-seventies of the last century and consists of a small pressurized water reactor of 512 MW. "Borssele-II" should comprise of a 2500 MW third generation nuclear reactor. Permitting procedure and construction will take approximately 8 years, and Delta estimates the total construction costs at € 4-5 Bln.

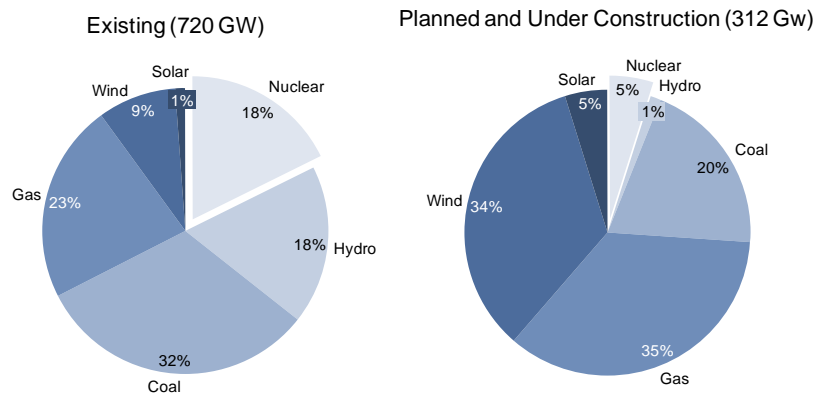
The Dutch have historically been divided on the nuclear issue, so -not surprisingly- Delta's ambitious plans have stirred up the debate. Supporters of the plan claim it is the only way to meet growing electricity demand in the Netherlands while complying with the EU CO<sub>2</sub> emission reduction targets. Opponents argue that the nuclear waste problem and safety issues have not been solved. They also believe that there is no direct need for a new nuclear plant given the moderate demand growth and the alternative opportunities in renewable energy.

In this debate not much attention is paid to the economic feasibility of the plan whilst historically, the economics of nuclear plants have been questionable, given the expensive reactors, long construction periods, and long payback periods. In this paper, we will discuss the economic viability of the Borssele-II project in three steps. First, the attractiveness of investing in nuclear power in Europe in general is assessed. Both the economics and the decision-making process will be discussed to understand why appetite for nuclear power is relatively low. Next, the specific Borssele-II case is assessed, and compared to power generation in Europe in general. For this, we will use our own financial model, and assessment methodology. Finally, the economic viability is tested specifically as an investment for Delta.

With the exception of the UK, the appetite for new nuclear power capacity in the EU is limited...

**Nuclear in the European Energy Market** – Nuclear plays a relevant role in the EU energy mix, representing around 18% of total installed power capacity. It provides for almost 30% of today's EU electricity demand. Since the Chernobyl accident in 1986, no new nuclear projects were initiated for almost two decades. Activity around nuclear has increased again the last few years, creating what some call "a nuclear renaissance". There are two new plants under construction in the EU today, one in Olkiluoto, Finland and one in Flammanville, France, totalling 3.2 GW. Another 14 GW of new nuclear capacity is planned, mostly in the UK. These numbers however, are dwarfed by the 175 GW planned and under construction in coal and gas, and over 120 GW in renewable energy in the EU. The role of nuclear power will thus diminish rapidly. Moreover, some nuclear facilities built in the 1970's will reach the end of their lifetime in the coming decade, limiting the role of nuclear even further. This seems to imply that most European utility companies do not consider nuclear power as viable or attractive at the moment.

**Figure 1: EU-27 Power Production Capacity Overview 2009 (GW)**



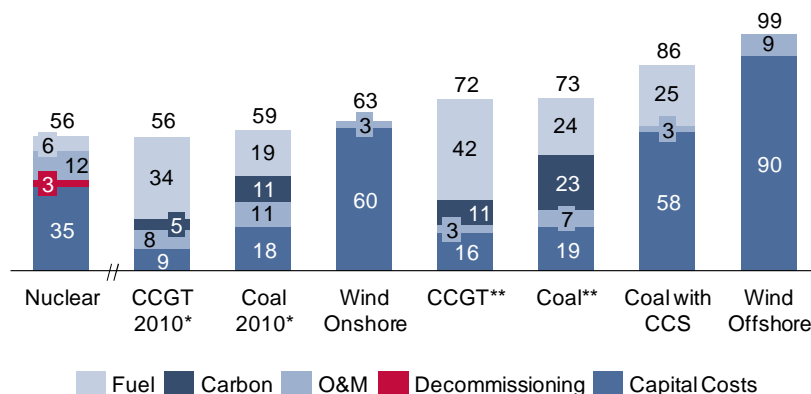
Source: Platts, Reuters, Euroelectric, IEA

...relative attractive levelised costs apparently are not the answer

This seems odd, given that the levelised cost of electricity from nuclear power has historically been one of the lowest of all generation methods. Even if ETS (The Emissions Trading Scheme) will not live up to its expectations, recent estimates of marginal costs indicate that nuclear can still be competitive. Moreover, most existing nuclear facilities in Europe have high utilisation rates and nuclear power has little exposure to future fuel prices, or cost of CO<sub>2</sub>.

There is apparently more to economics than the static levelised cost comparison. The lack of appetite for new nuclear power might be better explained by the high capital cost, the long construction period, the long payback period, and therefore the relatively high exposure to uncertainty with regard to future energy and power prices. These factors combined make that investments in nuclear can be categorized as a very high economic risks compared to investments in other energy generation methods.

**Figure 2: Levelised Electricity Cost of New Capacity 2010 (€/MWh)**

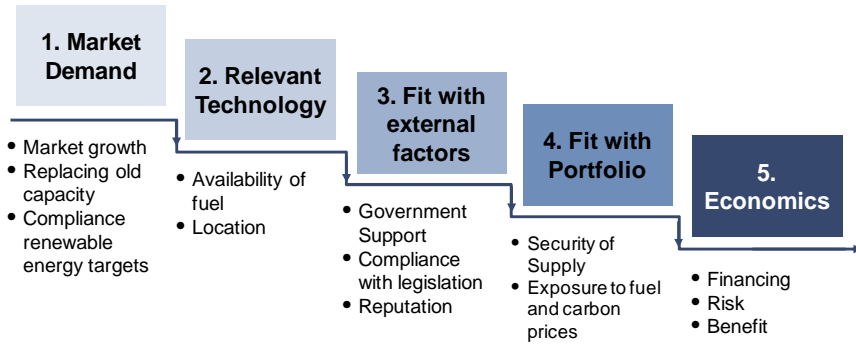


\*) Based on current cost of fuel and carbon (Coal, €65/ton, Gas €4/mmbtu, Carbon €13/ton)  
 \*\*) Based on long term futures of fuel and carbon (Coal €80/ton, Gas €6.5/mmbtu, Carbon €30/ton)  
 Source: Spring Associate (Assumptions in Appendix B), Nomura 2010

**European leading utilities have the economic position to build new nuclear...**

Almost all leading European utility companies have nuclear power in their portfolios. The majority of these companies are large, well capitalised companies that are familiar with large investments. Our experience working for these companies shows that the decision-making process to build new power generating capacity is broader than just a levelised electricity cost comparison. The forecasted electricity demand, the available technology options for the location, the legislative procedure, and especially the fit with the utility's portfolio are all part of the process.

**Figure 3: Decision-Making Process for New Build Power Capacity**

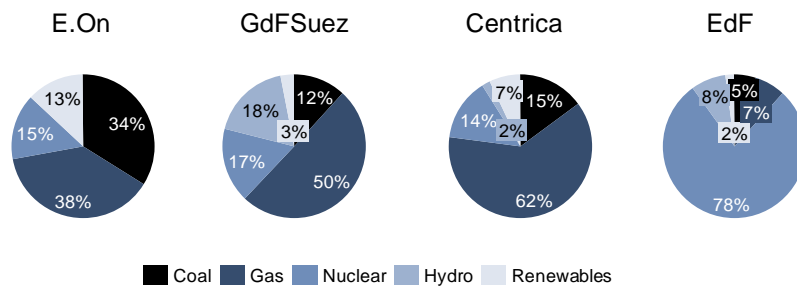


**...but the decision to build new nuclear is often halted based on broader considerations**

The new desired capacity will be based on the utility company's current installed capacity, the capacity that has to be replaced in the future, and the forecasted electricity demand. Eligible technologies are chosen with regard to desired capacity size, geographic location, and the availability of fuel. Government support and public opinion are also big contributors in the decision-making process, especially for nuclear.

It seems that in most cases the portfolio argument is decisive, as utility companies strive to balance their energy mix from various sources in order to hedge their exposure to fuel and CO<sub>2</sub> prices, and secure the supply of energy. For example, since gas reserves in the UK and Germany are declining, utility companies operating in these markets will choose to move their portfolios away from gas. There is room to grow in renewable technologies, and an incentive and obligation to do so, but most utility companies expect this cannot cover all the capacity that is needed for future demand. The EU renewable targets roughly match the expected demand growth in the next 10 years, but with the many phase outs of old plants, additional capacity is needed. Opting for nuclear could make sense if it can mitigate the exposure to fossil fuel prices and future CO<sub>2</sub> prices in the current power generation portfolio of the utility company. Only if all these factors indicate nuclear as one of the possibilities, the economic viability should be assessed, and compared to other options.

**Figure 4: Power Capacity Portfolio by Company 2009 (MW)**

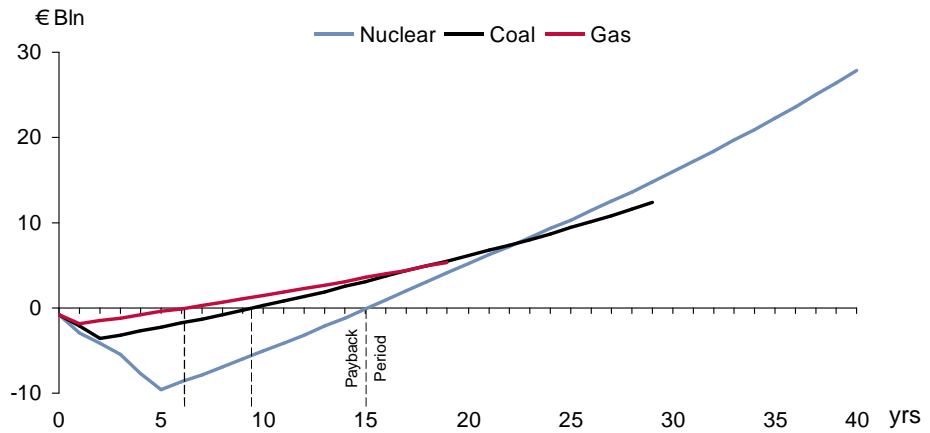


Source: Enerdata, Company data 2009

**The static economic case for new build nuclear is positive ...**

**Economic Viability Assessment** – The financial model used in our assessment provides a marginally positive rate of return for a 2.5GW plant. A construction cost of €3,000/kW is assumed. This is similar to the construction costs of the recently built nuclear plants in Asia, and the original projected construction costs for Olkiluoto and Flammanville. The construction period is assumed to be 6 years, similar the historic average of EU plants built in the 1970's and 1980's. The electricity price forecast is assumed at 2% annual growth, based on historical data and forecasts made by the Energy Research Centre of The Netherlands (ECN). Details of all assumptions are provided in appendix B. Given the base case assumptions, a nuclear plant would provide a rate of return (IRR) of 9% over a lifetime of 40 years. The payback would be 15 years.

**Figure 5: Cumulative Free Cash Flow for a 2.5GW Power Plant (€ Bln)**



Source: Spring Associates

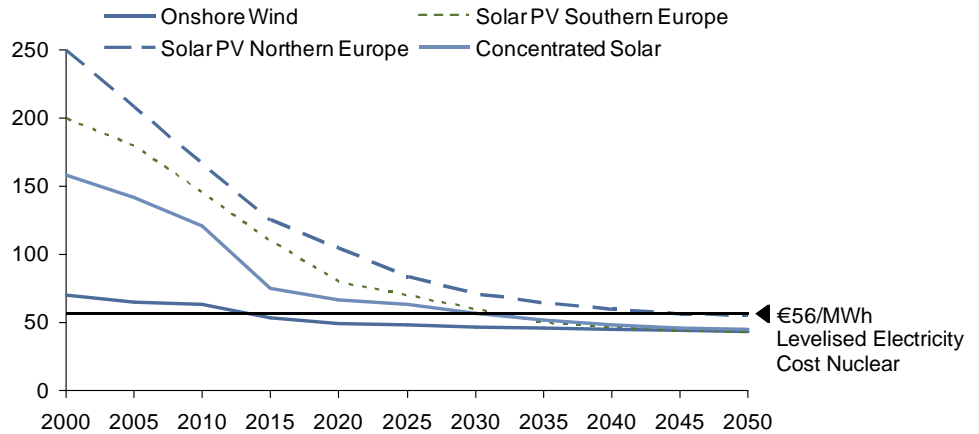
**...but construction delays and cost overruns constitute a major risk...**

This can be a positive investment case. Comparing the cash flows of a nuclear plant with those of a gas- or coal plant with the same capacity shows the relative high capital cost, long construction period, and long payback period for a nuclear plant. This reflects a higher risk for investment in nuclear. The steeper line for nuclear reflects the relative high cash flow after construction due to low cost of operations, fuel, and carbon. Varying the assumptions indicate that construction cost, construction period, and the electricity price forecast are the main drivers for the payback period and rate of return. Other assumptions that influence the payback period and rate of return significantly are the fuel costs, the cost of financing, and the total plant life.

The three main drivers have been set to historically observed - so, realistic - values to create low and high scenarios. In the high case, construction costs are kept at the original estimate. The construction period is shortened from 6 to 5 years, similar to the average construction time of nuclear plants in Asia, in the past decade. Long term electricity price increase is set at 3% annually, which reflects high demand growth and a moderately competitive electricity market. In the low scenario construction costs are set at 150%, and the construction period is prolonged with 3 years. This scenario is similar to the cost and time overruns of the Olkiluoto nuclear plant currently under construction in Finland. The electricity price forecast is lowered to 1% growth per year, simulating moderate demand growth and increasing competition on the electricity market.

...as does the uncertainty of long-term future electricity prices.

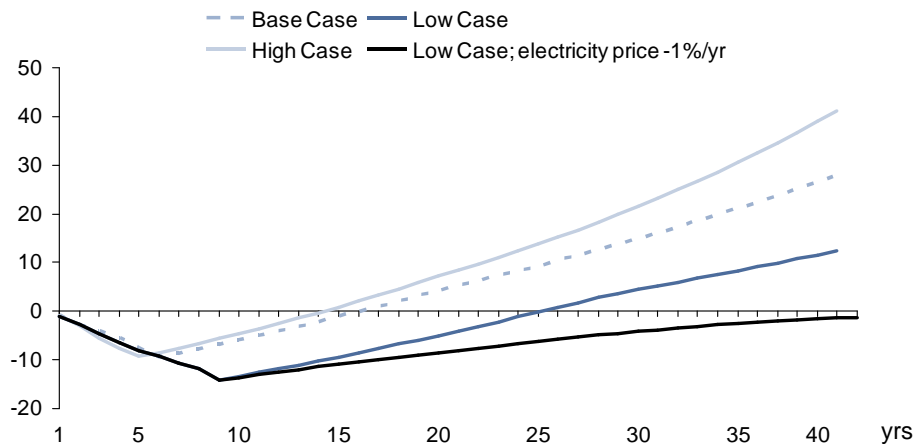
**Figure 6: Renewable Energy Cost Trends (€/MWh)**



Source: IEA, NREL, Spring Associates Estimates

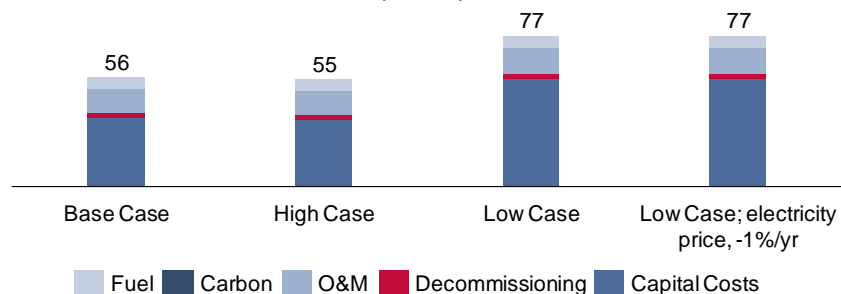
The development of the electricity price is the assumption with the highest uncertainty, given that it has to be forecasted for 40 years. Historically, the Dutch electricity prices have increased by 2% annually, but this does not necessarily hold true for the future. The liberalised electricity market could increase competition, driving prices down. Furthermore, strong growth in renewable technologies could drive prices down as well. If installed renewable capacity will continue to grow at a high rate, renewable electricity with zero or very low marginal costs could be competitive without subsidies in 5 to 15 years from today, depending on the location. Therefore, there is a good case to be made, that electricity prices could go down, instead of up, well within the lifetime of a nuclear power plant. To simulate this, a third scenario was added, similar to the low case, but with a declining annual electricity price of 1% after 5 years.

**Figure 7: Cumulative Free Cash Flow for a 2.5GW Nuclear Plant (€ Bln)**



Source: Spring Associates

**Figure 8: Levelised Electricity Cost (€/MWh)**



Source: Spring Associates

**Risk will have to be mitigated to justify the relative moderate upside...**

In the high case, the payback period is reduced to 13 years, and the internal rate of return is increased to 11%. The low case payback period is 25 years, with a return rate of 3%. In the low case with an electricity price forecast of -1% per year, payback is never achieved and the rate of return is negative. Given that even in the high scenario the cash exposure is € 9 Bln combined with a payback period of 13 years, the risk profile is very high for a moderate expected rate of return of 11%. The long payback periods in all scenarios require views of electricity price development for very long periods, which is a risk in itself. Overall it shows that expected returns are too low, given the risks attached. This implies that new build nuclear can only be considered economically viable if the risk of future uncertainties can be mitigated.

**...with large balance sheets, government guarantees, and contractor guarantees**

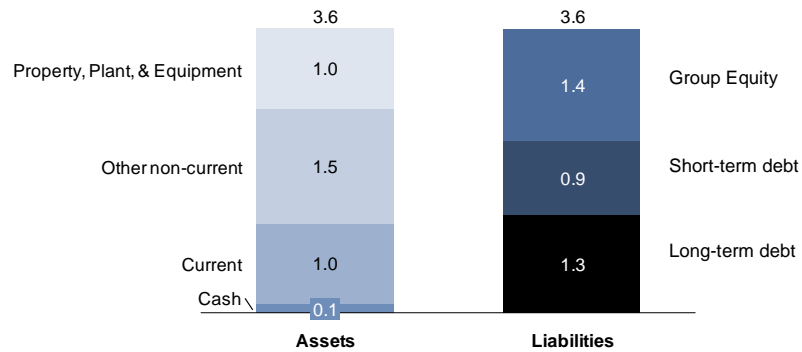
European and Dutch financial institutions confirm this. Finance for these types of projects in the EU could be obtained, but only if the risk is at least partially secured with guarantees that can cover the capital cost exposure. This could be done by direct recourse on the utility's balance sheet, a government guarantee, or guarantee by the contractor on the construction time and cost. The move of the Obama administration in this respect is illustrative, providing a \$14 Bln loan guarantee for two new nuclear power plants in the US. In practice a combination of all three factors would be applied until the lender feels comfortable with the residual risk. Financial institutions indicate they will particularly look for strong balance sheets of the executing companies that can cover cost overruns and construction delays.

Debt finance for new nuclear plants would be in the range of 50-70% in the current financial market. This is on the low side relative to the energy project finance average of 70-85%, reflecting the higher risk compared to other infrastructure and energy projects. It should be noted that in this theoretical exercise the crisis in the Dutch financial system, leading to very limited appetite of Dutch lenders for such a sizable financial operation, has not been taken into account.

**With Delta's financial position, and debt capacity...**

**Delta** – If we transpose the logic of financial institutions to the Borssele-II case, Delta would need to fund the project with between € 2-3.5 Bln, depending on the debt finance percentage. These funds could either come from Delta directly, or Delta could try to raise it.

**Figure 9: Delta Balance Sheet H1 2009 (€ Bln)**

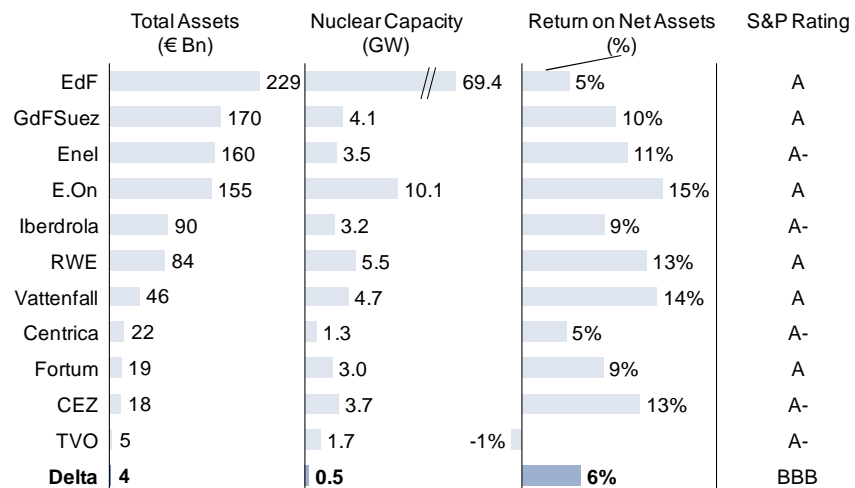


Source: Delta Financial Report H1 2009

According to Delta's financial statement in H1 2009, Delta's total balance sheet is € 3.6 Bln. It is evident that their current balance sheet, and particularly their cash position of €100 Mln, provides no room for an investment of € 2-3.5 Bln. Delta's EBITDA for 2009 is estimated at € 236 Mln, including earnings from its holdings in Borssele-I (EPZ), and the water company Evides. Net income for 2009 is estimated at €69 Mln. With this income, it is not possible for Delta to fund the project from its current cash flows. Delta would thus have to attract either more debt or more equity for this investment.

Delta's current net debt to EBITDA ratio is 2.8 According to their recent financial statement. The maximum debt to EBITDA ratio would be in the range of 3.5-4.5 for a general bank covenant. This would imply Delta is able to raise an additional € 200-400 Mln debt at best at the moment, which is nowhere near the amount needed for the Borssele-II investment. It is interesting to note the credit rating of Delta is well below the rating of the players in nuclear in Europe.

**Figure 10: Utility Companies with Nuclear Production Capacity in EU (Snapshot June 2009)**



Source: Company Financial Data, S&P, Spring Associates Analysis

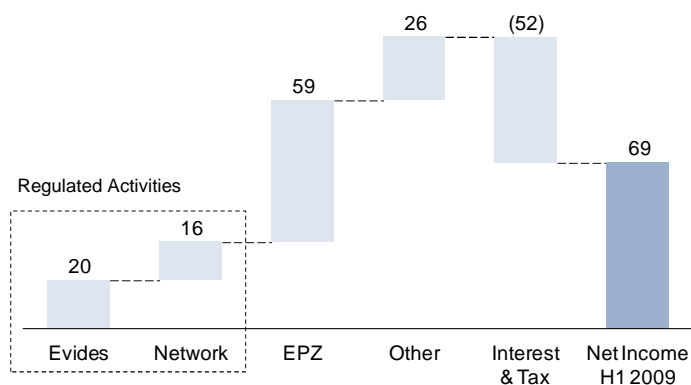


**...Borssele-II would not be economically viable for Delta**

A comparable reasoning applies to equity. Given Delta's current earnings, and future potential, it is unlikely that the company could attract new equity beyond € 200-400 Mln. Moreover, it is not clear how additional shareholder funds would influence Delta's public ownership status.

On top of this, Delta will have to divest their electricity network operations (DNBW) by 2011. Next to the obligatory divestment of DNBW, chances are high that Delta also has to divest their share in the regulated water businesses, Evides, in the near term. A debate is currently ongoing on the timeframe in which this should take place. Both of these regulated businesses provide a steady income for Delta, and without them Delta would already be close to their maximum debt capacity. To avoid breaking their bank covenants, Delta could lose some of its debt obligations by transferring debt to DNBW or Evides, However, a significant part of the company that generates a steady income will still be lost, and Delta's ability to attract debt or equity would decrease.

**Figure 11: Delta Income Estimate 2009 (€ Mln)**



Source: Delta Financial Report H1 2009, Estimates

**Conclusion** – According to our analysis, nuclear power itself not necessarily presents a negative economic case, although the investments are enormous with large uncertainties and very high risks. For a company like Delta with a relatively small balance sheet such an investment seems out of the question. With the divestment of Delta's regulated businesses in perspective, Delta's financial position will even deteriorate in the near future. Besides the ability to raise the funds for the required investment, the risks of construction delays and cost overruns are much larger than the value of the total company.

From this analysis it is logical to conclude that if Delta acquires the permits to construct, it will need a partner to build the project. Several European utilities would be capable to cooperate with Delta. However, these companies are much larger than Delta. Delta would be a very small partner with limited financial means to contribute. Thus cooperation on an equal basis is highly unlikely. This implies that pursuing the permit for such a project either results in a sale of the project, or even a sale of the whole company.

## Appendix A – Glossary

**Debt capacity** – The ability to borrow or the amount of debt a firm can repay in a timely manner (from available means or resources) without jeopardizing its financial viability.

**Emissions Trading Scheme (ETS)** – The European Union Emission Trading System (EU ETS) is a major pillar of EU climate policy. It covers more than 10,000 installations in the energy and industrial sectors which are collectively responsible for close to half of the EU's emissions of CO<sub>2</sub> and 40% of its total greenhouse gas emissions.

**Learning Curve** – The decrease in cost of a particular technology, expressed by the increasing amount of installed capacity of that technology.

**Levelised electricity costs** – The cost of generating electricity for a particular technology, including all the costs over its lifetime: initial investment, operations and maintenance, cost of fuel, and cost of capital.

**Marginal electricity costs** – The cost of generating electricity for a particular technology after construction of the plant.

**Payback period** – The period of time required for the return on an investment to "repay" the sum of the original investment.

**Return on net assets (RoNa)** – Net income divided by Net assets. A measure of financial performance of a company, which takes the use of its assets into account.

**Rate of Return (IRR)** - the effective compounded return rate that can be earned on the invested capital on an annual basis.

## Appendix B – Model Assumptions

	Nuclear	Coal	Gas
Construction costs (€/kW)	3,000	1,285	672
Construction time (years)	6	4	2
Fixed O&M costs (€/kW)	77.6*	39.3	26.1
Variable O&M costs (€/MWh)	1.7**	3.5	0.6
Fuel costs (€/MWh)	5.0	15.0	30.3
Carbon Emissions (kg/MWh)	0	750	350
Load Factor (%)	86%	85.5%	85.5%
Plant life expectation (years)	40	30	20
Electricity price escalation (%/yr)	2%	2%	2%

\* includes decommissioning fund. Decommissioning cost estimated at €1 Bln

\*\* includes waste fees of €1.4/MWh, equal to the Government regulated fee in France

## Appendix C – Source List

<b>Platts</b> - Platts Database ,Energy Products & Services	<a href="http://www.platts.com">www.platts.com</a>
<b>Reuters</b> - Reuters Commodity Database	<a href="http://www.reuters.com">www.reuters.com</a>
<b>Euroelectric</b> - Euroelectric website	<a href="http://www.euroelectric.org">www.euroelectric.org</a>
<b>IEA</b> - International Energy Agency Database	<a href="http://www.iea.org">www.iea.org</a>
<b>Nomura</b> - Nomura Brooker reports 2010	<a href="http://www.nomura.com">www.nomura.com</a>
<b>Enerdata</b> - Energy Price forecast Analysis	<a href="http://www.enerdata.fr">www.enerdata.fr</a>
<b>NREL</b> - Renewable energy learning curves	<a href="http://www.nrel.gov">www.nrel.gov</a>
<b>S&amp;P</b> - Standard and Poors company credit ratings	<a href="http://www.standardandpoors.com">www.standardandpoors.com</a>
<b>Rijkswaterstaat</b> - Coverage picture (B. van Eyck)	<a href="http://www.BeeldbankVenW.nl">www.BeeldbankVenW.nl</a>

**Company websites** - Delta, E.On, EdF, GdfSuez, Centrica, ENEL, Vattenfall, Iberdrola, RWE, Fortum, CEZ, TVO