

## Viking Link – An Investment with an Uncertain Payback

The investment in the planned 1.4 GW Viking Link between Denmark and Great Britain will be 13.4 billion DKK (or 1.6 billion £) [3]. It is hard to imagine how an electricity link can pay interest on such amount of money. Therefore, this note tries to understand the sources of revenue.

### Large Differences in European Wholesale Prices

The price levels in the European wholesale markets are very different. The price differences indicate an inefficient European electricity market.

I have argued that the main reasons are grid bottlenecks and market imperfections. A third reason is different electricity taxations. *Therefore, the wholesale prices should be equalized by a combination of grid reinforcements, market consolidation and tax harmonisations.*

There are different opinions on the best combination of these measures. New transmission capacity is a rather expensive measure.

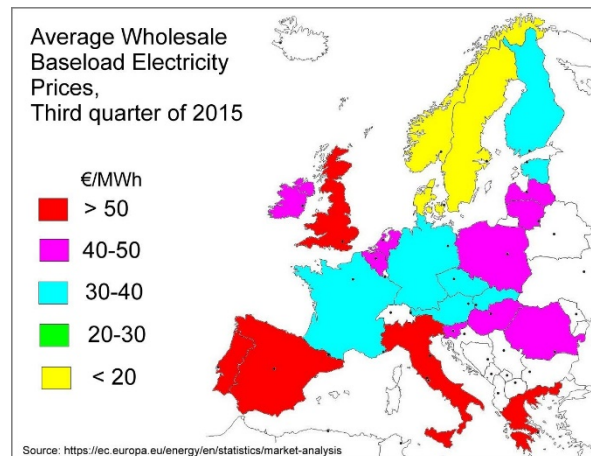


Fig. 1 - Average wholesale electricity prices

### e-Highway2050 – A European Grid Vision

EU's Seventh Framework Programme has supported a study on ways to remove 95% of the CO<sub>2</sub> emissions in EU by 2050 with grid reinforcements as the preferred measure.

A booklet [1] gives an excellent overview of assumptions and results. A large number of clarifying documents are available at the project's homepage [2].

Based on five scenarios, a least regret grid 2040 has been developed (fig. 2). It includes the development of transmission corridors from north to south, but less distinctly corridors from west to east.

The Viking Link has not been rejected. It has simply not been considered.

The grid investments from 2030 to 2050 are estimated to be between 120 billion € and 640 billion €. New analyses must show if there is a cheaper way.

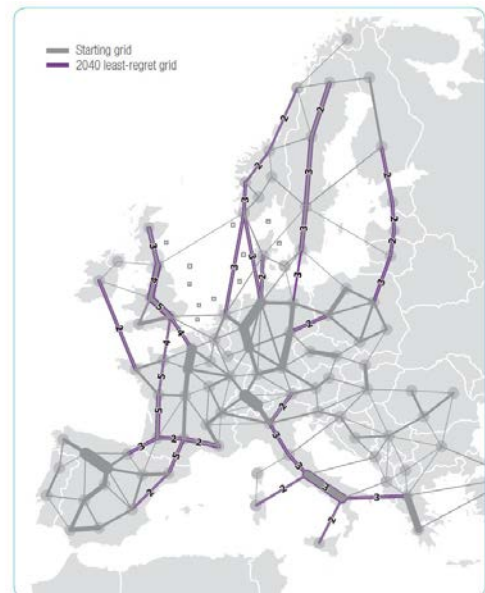


Fig. 2 - The least regret grid 2040

## An Investment with more than 20 Years Payback Time

A report from EA Energy Analyses is the main source [3]. Energinet.dk has published its public combined business case [4] for the Viking Link and the new west coast line to Germany. "Public" means that all essential data is removed.

The total investment is 13.4 billion DKK [3]. EU will support the project ("Projects of Common Interest"). The Danish share will be 7.943 billion DKK [4]. It follows that the British share will be less than 5.5 billion DKK.

It will be a condition for utilizing the full capacity of the link for import to Denmark that the west coast line to Germany has been commissioned.

The difference in average wholesale electricity prices in Denmark and Great Britain is the essential source of revenue for the link (fig. 3).

GB is supposed to maintain a price level at 400 to 450 DKK/MWh, while the Danish price is assumed to increase from 250 DKK/MWh to about 400 DKK/MWh until 2030.

Based on the total investment and the capital cost in fig. 4, the annual interest rate in the calculation has been estimated at 4.6%.

During the first years, the capital costs will exceed savings in fuel cost. The loss will be 200 million DKK the first year of operation.

The increased revenue from 2030 to 2040 is decisive for the result of the profitability calculation. The reasons for that increase are not clear.

According to [3] the net present value (NPV) in 2020 for a 30 years period is approximately 5.6 billion DKK. Based on this figure and an interpolation between the three savings in fig. 4, we shall try to replicate the profitability calculation.

The three decades will be analysed one by one.

From 2020 to 2030, there are two years with profit and 7 years with losses. The result for that period (NPV in 2020) is -584 million DKK.



Fig. 3 - Average electricity prices DKW and GB [3]

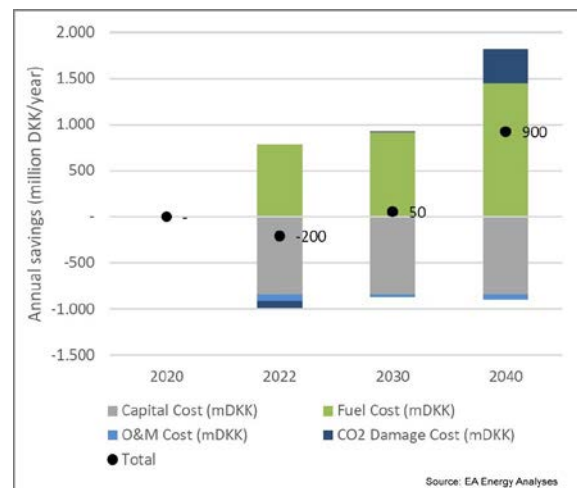


Fig. 4 - Annual savings [3]

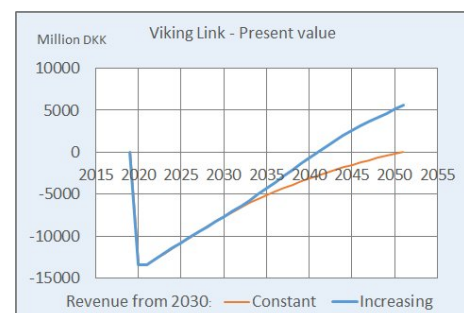


Fig. 5 - At least 20 years payback time

For 2031 to 2040, NPV in 2020 is 2,441 million DKK.

The years 2041 to 2051 are identical with 2040. The NPV in 2020 is 3,718 Million DKK.

NPV in 2020 for the whole period is 5,575 million DKK, which is in fair agreement with the 5.6 billion DKK.

The problem is that the first seven years of operation are expected to be loss giving. The decision on investment depends on expected profits several years ahead, when the present assumptions are rather uncertain (fig. 5).

### Uncertainty about Future Price Differences

According to [4] Great Britain is expected to set its own market prices for electricity, even when all planned interconnections have been installed. Arbitrage between large market areas is the driving force.

In 2020, gas fired units are expected to be price setting in the British electricity market most of the hours. In Germany lignite and coal are price setting more than half the year. This is one reason for the price difference.

Another reason is the British carbon price floor (CPF). CPF requires industries to pay a top up if the market price for carbon falls below a certain level. The carbon price support (CPS) is currently £ 18 per tonne CO<sub>2</sub>, which is added to carbon price in the EU-ETS (Emissions Trading System).



Fig. 6 – Marginal costs and price setting hours in DE and GB 2020

The question is how these differences will develop until 2050. In [3], it is assumed that carbon prices will be the same in Great Britain and Denmark from 2030 (fig. 7).

Nevertheless, the revenues for the Viking Link project are assumed to increase considerably from 2030 to 2040.

This is surprising. The increasing share of fluctuating production may cause more price volatility and better trading opportunities. Increasing fuel and carbon prices may also contribute to the higher revenues.

On the other hand, more interconnections, better market arrangements and harmonized taxations should gradually reduce the differences in wholesale prices in Europe. It is difficult to assess if the trend upwards or downwards will prevail.

Unfortunately, details on the assumptions for the years between 2030 and 2050 are not available, but due to the long time horizon, even the best forecast must be rather uncertain. Therefore, it is a problem that Viking Link will not be able to make profit during the first many years after its installation.

### Socioeconomic Losses the first Years

The import to Great Britain during the first year of operation is expected to replace 6.5 TWh electricity from gas-fired units [3]. The import will reduce the British carbon emission by approximately 2.6 million tons and reduce the CPS by £ 47 million.

Of the additional production on the supply side approximately 2 TWh is coal-fired, 1 TWh is gas-fired and 2 TWh is hydro [3]. The additional carbon emission is approximately 1.9 million tons. *From a global perspective the emission reduction is only 0.7 million tons in 2022.*

The average difference between British and Danish electricity prices will be about 80 DKK/MWh in 2022. The carbon cost difference is approximately 150 DKK/ton in 2022. It explains a difference in electricity prices of about 64 DKK/MWh. It indicates that most of the revenue from the project in 2022 is caused by the difference in carbon cost.

Nevertheless, the project will be loss giving the first 7 years of operation.

The total estimated revenue in 2022 is about 700 million DKK (£ 85 million, exchange rate October 2016). The reduced CPS would be £ 47 million. Will more than half the revenue be at the expense of British taxpayers?

It is clear from [3] that there is a problem. It says (p. 61): *Price difference between Denmark and Great Britain is partly driven by different CO<sub>2</sub>-taxes, which do not reflect socioeconomic savings.*

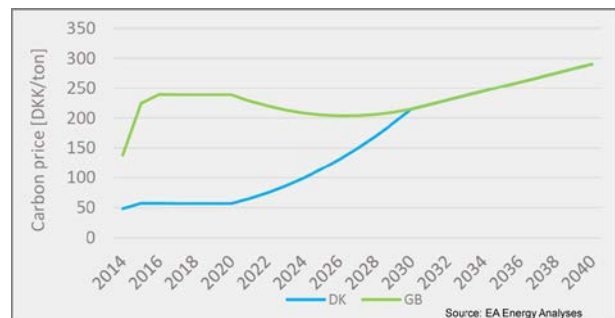


Fig. 7 - Assumed carbon prices in Denmark and Great Britain [3]

By interpolation between 2022 and 2030, the net present value (2020) of the lost tax revenue has been estimated at 1,471 million DKK. Above we found a loss for that period at 584 million DKK. A socioeconomic NPV in 2020 including the interests of British taxpayers would be a loss exceeding 2 billion DKK.

*The result indicates that if a socioeconomic analysis were a decisive argument in the decision-making, the installation of the Viking Link should be postponed.*

## Strategic Considerations

The expansion of electricity transmission systems must be planned for a very long period ahead. Other considerations than short-term economic results can be decisive.

Since the 1960s, it was important to West Denmark to establish a hub in the European electricity grid. Some projects involved technological pioneer work and considerable economic risks. The technological problems were solved and most projects were profitable from the beginning.

The interconnection between West Denmark and Germany was always an important lifeline, both commercially and for the security of supply. During the last few years, the export capacity has been gradually reduced, in an increasing number of hours to zero. The reasons are the wind power expansion in the northern part of Germany, bottlenecks in the German grid and the German market arrangement with one price zone for Germany, Austria and Luxembourg.

The Cobra-cable to the Netherlands (under construction) is an important measure for bypassing the German bottlenecks.

The west coast line to Germany combined with Viking Link is a grandiose plan. The Danish investment in these projects will be quite high, and the profitability depends on uncertain conditions decades ahead. The basis for the decisions is secret.

It should be possible to explain publicly the reasons for the surprising increase in revenues from the Viking Link project after 2030 without revealing commercial secrets.

Other public projects with unrealistic economic assumptions have been decided in the past. If the calculated profitability for Viking Link were optimistically biased, it would be fair to admit the uncertainty publicly and add the explanation that other considerations have been decisive in the decision-making process.

### **References:**

1. Europe's future secure and sustainable electricity infrastructure, e-Highway2050 project results, November 2015
2. <http://www.e-highway2050.eu/results/>
3. "Integration af vindkraft, Viking Link og andre tiltag for integration af vind", EA Energy Analyses, November 2015 (in English from page 9 to page 68)
4. Energinet.dk: Business Case – Vestkystforbindelsen og Viking Link, 9. november 2015 (in Danish)