Economics of Interconnection: the Case of the Northwest European Electricity Market

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Introduction

In order to create an internal European market for electricity, interconnection lines between several European countries are being developed. The Dutch market, now only directly connected to the German and Belgian market, will be linked to the Scandinavian and British market in 2008 and 2010, respectively. Economically, these investment projects raise several fascinating questions. As the costs of the investments amount to hundreds of millions of euros, while the benefits are fairly uncertain, the profitability is a key issue to be dealt with. This regards the efficiency on both business level and general level. Questions to be answered are: can the investments be financed from the business returns and, if not, are the investments profitable from a general economic (welfare) point of view? The answers to these questions are directly linked to the issue of the institutional organisation: should the responsibility for these investments be solely left to the public TSO or should privately owned firms be given the option to also be involved?

In this paper, we deal with these issues by discussing the economics of the investments projects which will link the Dutch market to the Scandinavian market (NorNed-cable) and to the British market (BritNed-cable). Regarding the NorNed-cable, we go into the overall welfare effects, while the institutional aspects is discussed referring to the BritNed-cable which is a (commercial) merchant cable. The respective questions which we answer are:

a. do the overall economic benefits of the NorNed-cable (likely) exceed the investment costs?
b. what is the added-value of the possibility of commercial investments in interconnection, such as the BritNed-cable?

Welfare Effects of Interconnection: the Case of NordNed[1]

In 2008 the Nordic and the Dutch power market will be connected through NordNed, a transmission cable between Norway and the Netherlands. This cable, developed by the Dutch and Norwegian transmission system operators (TenneT and Statnett, respectively), has a length of 580 kilometres and a capacity of 700 MW. The cable will be used to daily arbitrage between the markets in the two regions: if, for instance, the Dutch price is below the Norwegian price, electricity will be bought on the Dutch spot market (APX), which is already linked to the markets in Germany, Belgium and France, and sold on the spot market in Oslo, Nord Pool, which is the common Scandinavian power exchange, linking the markets of Denmark, Finland, Norway and Sweden.

How should we assess this interconnection, economically? In order to determine the overall economic effects, we use a cost-benefit framework. Compared to the benefits, the costs of the investments are rather clear. The costs mainly consist of the investments which have already been made. The investment costs are about 550 million euro. Future costs, consisting of annual maintenance costs, constitute a relatively minor part of total costs. These future annual costs are estimated at about 4 million euro.

The benefits of NorNed, however, are rather uncertain as these have to be realised in the (near and long term) future. Moreover, the benefits include several components which are difficult to monetarize. The main benefit will follow from price differences between the Scandinavian and Dutch regions, while other benefit items may derive from impacts on competition and security of supply.

Benefits from Price Differences

These benefits, logically, only occur if the power price differs between the two power markets. Price differences may result from different factors, in particular differences in generation techniques and in demand profile.

In the Nordic markets, electricity is mainly generated by hydro plants, while in the Netherlands gas-fired and coal-fired plants dominate the generation mix. Hence, the Dutch supply is highly sensitive to changes in fossil-fuel prices, while the Nordic supply strongly depends on the availability of water.[2] These large differences in generation techniques constitute a major source of price differences.

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See footnotes at end of text.

Moreover, Dutch supply is characterised by a fairly steep merit order (caused by the strong variation among power plants which have limited capacities), while the Nordic supply curve is rather flat (resulting from its fairly homogeneous generation method). Because of these characteristics, Dutch power prices are strongly related to the size of the demand, while Nordic prices can be rather stable in the short term, provided that the level of water reservoirs remains sufficient to meet (growing) demand.[3]

Finally, the demand profile of Dutch electricity users also differs from Nordic consumers. In the Netherlands, electricity is mainly used by non-residential users (such as large industrial users), while in Norway, residential use is relatively important (about one-third of total consumption), in particular in winters for heating purposes.[4] As a result, Dutch prices strongly vary between day and night, which offers opportunities to export during night time and import during daytime.

So, price differences between the Dutch and the Nordic markets form a potentially significant source of benefits of the interconnection. Acknowledge, however, that these benefits are not equal to the welfare effects, as they mainly consist of distribution effects. After all, transport of electricity from a low-price region to a high-price region raises prices in the former region and reduces them in the latter, affecting all power users in both regions.

The real welfare effect compromises both productive and allocative efficiency. The productive-efficiency effect follows from the increased efficiency of generation. The interconnection enables a more extensive use of the cheapest method of generation. If, for instance, (marginal) costs of producing electricity is high in the Netherlands compared to Norway, it is welfare enhancing to generate the (marginal) power in Norway in stead of in the Netherlands. The allocative efficiency benefit of the interconnection follows from the fact that the price level will get closer to the level of the marginal costs in both regions. Without interconnection, some consumers do not use power because the price they have to pay exceeds their willingness-to-pay while the latter exceeds the marginal costs. Note, however, that the relatively low price elasticity of demand implies that the allocative benefits of the interconnection will not be large.

Benefits from Enhanced Competition

In addition to the benefits following from price differences, benefits from enhanced competition may result from the interconnection. Competition in the Dutch power market is stagnating owing to the limited number of players.[5] In many hours one or more players are pivotal in meeting demand, although they are not necessarily always the same players. The high degree of concentration and the regular pivotality of one or more players have an impact on market outcomes: the greater the pivotality, the more the electricity price differs from the underlying costs of production.

If the available interconnection capacity increases, prompting other providers to enter the wholesale market, the current players will be pivotal to a lesser extent or less frequently. As a result, the wholesale price (particularly during peak and super-peak hours) will decrease. Due to the competition in the end user market, this price benefit will be largely passed on to the consumer. Consumers will also benefit indirectly, since lower electricity prices will be reflected in lower product prices.

These benefits mainly comprise distribution effects, as they are the result of a transfer from producers to consumers. In addition, enhanced competition will likely result in some benefits for productive efficiency, owing to an increased dispatch efficiency, and for allocative efficiency, because of less distorted prices.

Benefits from Increased Security of Supply

Another benefit from the interconnection is that the security of supply can be realised against lower costs. In an isolated market, more installed generation capacity is needed than in larger markets. Due to the NorNed-cable, the Norwegian hydro storage capacity can be lowered, just as the Dutch can reduce the size of the installed generation capacity necessary to meet peak demand. In both regions, market forces will take care of these effects. As the interconnection will reduce the volatility of prices in both regions, the efficiency of capacity which is hardly used will decline. In the long term, this will result in a lower level of installed capacity.

Overall Economic Assessment

Investments in interconnection do not automatically generate positive welfare effects, as the upfront costs are significant while the benefits are fairly uncertain. Regarding the NodNed-cable, the Dutch energy regulator concluded that the overall economic effect will be slightly positive, although benefits from enhanced competition and the benefits for security of supply were not monetarised.[6] Inclusion of

these benefits in the cost-benefit analyse results in an investment project which seems to be beneficial. The future will teach us whether this expected efficiency will be realised or not.

Merchant Lines Within a Public Network: the Case of BritNed[7]

In 2010 the British and the Dutch power market will be connected through BritNed. This DC transmission cable is developed by a joint venture of the British and Dutch TSO (National Grid Company and TenneT, respectively). This cable will have a length of 250 kilometres and a capacity of 1000 MW. This cable will be used as a merchant cable. How should we assess such a commercial investment within the publicly owned transmission network?

European Regulatory Framework

The regulatory framework in the European Union allows for merchant investments in transmission provided a set of conditions is met. The European approach is laid down in the EU Regulation on Cross-border Exchanges which entered into force July 1, 2004. This regulation allows for new interconnectors to be exempted from rules that regulate the revenues of allocation of scarce interconnector capacity and from rules that require (regulated) third party access to the network.

The exemptions can only be granted under the following conditions:

- the merchant interconnector should enhance competition in electricity supply;
- the level of the risk is such that the investment would not take place unless the exemption is granted;
- the interconnector must be owned by a person legally separate from the TSOs (so no full ownership unbundling is required);
- charges must be levied on users of the interconnector;
- since the start of the European electricity liberalisation, no part of the capital or operating costs of the interconnector has been recovered from any component of the network tariffs;
- the exemption is not to the detriment of competition or the effective functioning of the internal electricity market or the efficient functioning of the regulated systems to which the interconnector is linked.

Opening interconnection investment to private parties has not yet led to a significant increase in power transmission investment projects. Only two merchant investments in power transmission have been granted exemption in Europe (the Estlink and the BritNed interconnectors). Moreover, in both cases TSO holding companies are the investing companies, so that the two projects are nor real merchant projects.[8] Below, we discuss a number of pros and cons often attributed to merchant lines.

Compensating for Lack of Regional Coordination

It has been argued that the possibility of merchant investments is necessary as in case of regulated investments the authorities at the side of the low-price market might be reluctant to increase the transmission capacity, since that investment would raise the local power price. Merchant investors might compensate for the lack of coordination between national authorities and TSO.

This argument has been weakened by the recent legislative proposals of the European Commission concerning the electricity and gas market (the 3rd Package). The Commission proposes, among others, to establish an Agency for the cooperation of energy regulators (hereafter: Agency). This Agency would complement at European level the regulatory tasks performed at national level by the regulatory authorities. One of the proposed tasks of the Agency is the granting of exemptions from third party access rules where the infrastructure concerned is located in the territory of more than one Member State. By bringing the authority for granting exemptions at a EU level, the above argument in favour for merchant investments has disappeared.

Suboptimal Decisions of TSO

Another argument in favour of merchant investments is the perceived problem of under-investments in case of vertically integrated utilities. Such a utility might have the incentive not to invest in cross-border capacity in order to protect its generation activities in its own market. Also this second argument would disappear with the implementation of the new EU energy package as ownership unbundling of TSOs is a core element (and also the most criticized element) of the package.

Suboptimal Decisions of Regulators and Regulatory Uncertainty

Suboptimal behaviour can also be caused by lack of (political) willingness to allow regulated investments in certain transmission lines although they would be socially optimal. Despite the social benefits, the consequence normally is that regulated transmission tariffs will have to be increased.[9] Such behaviour might happen especially in cases of several investment projects being proposed.

Regulatory uncertainty might also hamper investments in regulated lines. The TSO faces the risk that a regulator might change the rules after the investment has been done. This might lead to under-investments especially in case of large investments.[10]

Both arguments are not of fundamental nature. However, it can be not denied that these arguments can become relevant in practice.

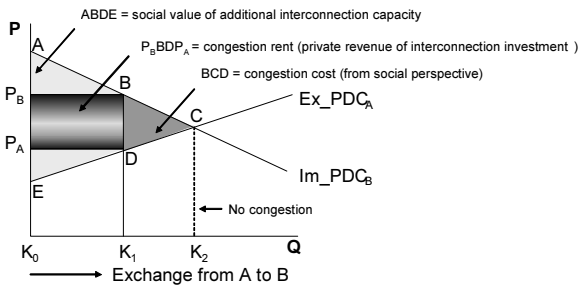
Private Investors are Said to be More Efficient

The last and more fundamental argument to allow for merchant investments is that a private investor has stronger incentives to produce efficiently. This incentive is normally less strong for (publicly owned) TSOs in case of regulated investments, although it depends on the regulatory approach. In the case of the NorNed-cable the Dutch regulator has included several incentives in its decision to allow for the investment. Incentives are placed on the total project cost, the timely delivery of the project and the capacity and availability of the cable. It is too early to assess whether these incentives have proved to work. Theoretically, however, these attempts to increase incentives on TSOs (and to shift the risk for consumers towards TSOs) will never be perfect.

Argument Against Merchant Lines

The above might lead to the suggestion that the possibility to allow for merchant investments in power transmission is not necessary. Two main arguments would disappear with the implementation of the 3rd EU legislative package. Two more arguments would not apply in case of proper regulatory approaches. And the last and more fundamental argument could be weakened if innovative regulatory incentive schemes could be implemented. However, the question could also be turned around. Why should we not allow for the possibility of merchant investments? Two arguments against merchant lines should be mentioned.

Network externalities may arise, as the use of the line cause loop flows in other parts of the network. These loop flows affect the efficiency of other parts of the network, but they are not taken into account by the merchant investor.



Another argument against merchant lines is that merchant investors have the incentive to maintain bottlenecks in order to keep price differences. As a result, the capacity of a merchant line is likely below the socially optimal level. This is illustrated in the adjacent figure.[11] The horizontal axis represents the interconnection capacity between two nodes A and B, whereas the vertical axis gives the price in each node. A merchant investor will try to maximise the congestion rents, represented by P_BBDP_A, whereas the total social value of additional interconnector capacity is represented by ABDE.

These two arguments become even more important in cases where the TSO is involved in the merchant project (which is the case for both BritNed and Estlink). The TSO might have an incentive to operate the system with the objective to maximise the revenues of the merchant project.

Conclusion

Extending the interconnections between countries enlarges the market which potentially increases the productive efficiency of power generation, enhances competition and improves security of supply. The interconnection between the Nordic and Dutch market by NorNed as from 2008 will produce these benefits, which will likely exceed the costs of developing and maintaining the interconnection. Nevertheless, uncertainty about the efficiency remains. Generally, cost-effective alternatives for physical extension are enlarging the availability of already existing lines and improving the possibilities for effective cross-border trade (e.g. by creating options for cross-border intraday trade). Moreover, it is important to note that even in well connected regions, transmission costs remain. In many cases, investments in new power plants within a region will be a cost-effective alternative for developing or extending interconnection lines. So we stress the importance of systematically analysing the costs and benefits before making the

final investment decision on interconnection.

Merchant interconnection lines may have an added value, but this value will likely be reduced by the new proposals of the European Commission. The 3rd legislative package of the EC aims to tackle the market integration process, in which interconnections play a key role, by ownership unbundling of TSOs and establishing stronger and independent regulatory authorities. Regional cooperation is then facilitated by an Agency and a European Network of TSOs. This approach should provide a better framework for regulated investments in transmission projects and, therefore, reduces the need for merchant lines. The possibility of merchant investments is still left open, which is important as the merchant option has several advantages. Special attention, however, should be paid to the risk of strategic behaviour by TSOs if TSOs are involved in the merchant project.

Footnotes

[1] See also Carel van der Lippe en Paul Meijer, De NorNed-kabel: een gereguleerde investering met betekenis voor de markt, Tijdschrift voor Politieke Ekonomie, 2005(27)2, pp. 79-92, and: Michiel de Nooij, Leren van NorNed, ESB, 13 juli 2007, pp. 429-431.
[2] Energy Systems Analysis (ESA), Background study – Balancing system of Denmark, 2004.
[3] See for instance S.J. Koopman et al., Periodic Seasonal Reg – ARFIMA – GARCH Models for Daily Electricity Spot Prices, Tinbergen Institute, 2005.
[4] Source: www.iea.org.
[5] NMa-DTe, Market Monitor: Development of the Wholesale Electricity Market in 2006, The Hague, 2007.
[6] DTe, Besluit op de aanvraag van TenneT tot het toestaan van de financiering van de NorNed-kabel op grond artikel 31, zesdelide van de Elektriciteitswet 1998, besluit 101783-2-76.
[7] See also G. Brunekreeft en H.M. Godfried, Netverbindingen door markt, ESB, 19 maart 2004.
[8] See also Rudi A. Hakvoort and Hanneke M. de Jong Pushing European power transmission: Private investment in priority interconnections?, EREM, 2007
[9] See also Rudi A. Hakvoort and Hanneke M. de Jong Pushing European power transmission: Private investment in priority interconnections?, EREM, 2007
[10] See also G. Brunekreeft and H.M. Godfried, Netverbindingen door markt, ESB, 19 maart 2004 (in Dutch)
[11] See Rudi A. Hakvoort and Hanneke M. de Jong Pushing European power transmission: Private investment in priority interconnections?, EREM, 2007

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