ENERGINET Statnett

Application to introduce implicit loss handling on the Skagerrak Interconnector

The enclosed document contains the rationale for the joint application of Energinet and Statnett to introduce implicit loss functionality on the Skagerrak interconnector. The document includes a description of the applied-for method and an assessment of the expected socio-economic consequences, including distribution effects, from introducing implicit loss handling on the Skagerrak Interconnector. Further, Appendix 1-3 respectively include further description of the principle, the socio-economic analysis and analysis of intraday arbitrage.

The implicit loss functionality will be implemented by the introduction of a fixed annual loss factor for the Skagerrak Interconnector. The loss factor will be adjusted annually based on historic median flow for all hours with flow for the Interconnector. The annual socio-economic gain from introducing implicit loss handling for the Skagerrak Interconnector is estimated at approximately EUR 0.9 million for Norway and EUR 2,3 million for Denmark.

The title and thus the scope of Annex I to Regulation 714/2009, “Guidelines on the management and allocation of available transfer capacity of interconnections between national systems”, support the Annex having a substantial legal significance of its own. For example, the Annex may provide a legal basis for introducing methodologies of cross-border significance on an interconnector.

As an EEA EFTA State, the Norwegian parliament has voted to incorporate the EU’s 3rd Energy Package, including Regulation 714/2009, into national legislation. However, the entry into force of that legislation is contingent on adoption by all EEA EFTA States, and adoption by Iceland is still lacking. Consequently, Regulation 1228/2003 of the EU’s 2nd Energy Package still applies for Norway. Fortunately, the Commission’s Decision 770/2006 has amended the Annex to Regulation 1228/2003, thus forming the basis for the subsequently adopted Annex I to Regulation 714/2009. Accordingly, the legal basis for the following bilateral procedures for the matter in question is stated in the following.

The Annex to Regulation (EC) No 1228/2003 of the European Parliament and of the Council of 26 June 2003, as amended by Commission Decision No 770 of 9 November 2006, is similar to Annex I to Regulation (EC) No 714/2009 of the European Parliament and of the Council of 13 July 2009. In particular, it is emphasised that paragraph 3.1 in the Annex to Regulation 1228/2003, is similar to the same paragraph 3.1 in the Annex I to Regulation 714/2009. Thus, that particular paragraph states in part that congestion management expected to affect physical flow in any 3rd country significantly shall be coordinated at both TSO and NRA level.

The relevant legal basis in Norway for the introduction of implicit loss factor on the Skagerrak Interconnector is the Norwegian Energy Act and in particular Statnett’s “Concession for interconnectors to other Nordic countries”. It follows from Section 5 in that concession that transmission losses should be taken into account in the energy-trade if loss functionality is available in relevant trading systems. Moreover, according to Section 7, all amendments to existing agreements and new agreements of significant importance which fall within the scope of regulation in this license shall be submitted to the Norwegian Water Resources and Energy Directorate for approval well in advance before they enter into force.

In addition, relevant provisions of Regulation (EC) No 1228/2003 including the Annex to the Regulation will apply. The Annex to Regulation 1228/2003 is aligned with Annex I to Regulation 714/2009 as a result of the Commission’s decision 770/2006.

The relevant legal basis in Denmark for the introduction on implicit loss factor for Skagerrak is solely Annex I of Regulation 714/2009, in the sense that directly applicable EU law in terms of Regulation 714/2009, and/or the Commission's regulations on network guidelines, the CACM Regulation etc., replace any national Danish provision on the actual subject of the matter, the introduction of methodologies etc. on a cross-border interconnector.

By the same token, the Danish Utility Regulator as the national regulating authority of Denmark has the authority to issue administrative decisions on the legal basis of directly applicable EU law. See Section 1, Subsection 2, no. 4, in the Act No. 690 of 8 June 2018 on the Danish Utility Regulator.

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Implicit loss handling on the Skagerrak Interconnector

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1. Rationale for the application

When current flows in an electrical network, some of the energy will be lost through heating of the electrical components, and the power volume that reaches end users will thus be less than the volume produced. On HVDC interconnectors between Norway and other countries, this loss will be between three and five per cent. However, the electrical loss, which constitutes a large socio-economic cost, is not included in the pricing in the power market. Without intervention from TSOs, agreed production and consumption (after market clearance) will therefore result in a balanced market, but without an operationally balanced system.

The operational imbalance caused by losses on the Skagerrak Interconnector is currently handled by the TSOs buying power to cover the transmission losses[1] so as to ensure that the system is in balance both market-wise and operationally. “Explicit loss handling”, which is used for the losses both in the AC grid and on HVDC interconnectors, is regarded, however, as an ineffective way of handling losses.

The TSOs’ purchases of losses affect the power price but are not linked to the transmission interconnector(s) where the losses actually occur. This means that the market participants are not provided the price signals necessary to take into account their influence on the electrical loss. Electrical losses thus represent a negative external effect that results in an unnecessary socio-economic loss. This can be directly observed in the fact that power is traded between bidding zones at times where the value of the power trade (the price difference) is less than the cost of transmission losses. By taking into account (internalising) electrical losses in the market price, a socio-economic gain can therefore be achieved.

In the AC grid, the electrical losses are partially internalised through the grid tariff in which a loss component ensures that the participants pay a tariff according to bidding zone and time of day that reflects electrical losses. On HVDC interconnectors, the losses can be internalised through “implicit loss handling”. Statnett and Energinet have therefore worked on implementing the solution on their shared HVDC interconnector, Skagerrak[2].

2. Method for implicit loss handling

With implicit loss handling, the electrical losses are represented in the market through a new limitation in the market coupling. This ensures that exported volume is reduced by a loss factor between exporting and importing bidding zones. The market prices will thus be affected by the new restriction so that:

With congestion: ***Export price < (1 - Loss factor) * Import price***

Without congestion: ***Export price ≤ (1 – Loss factor) * Import price***

This change will ensure that power is not traded on an interconnector unless the value of the trade is greater than the loss cost.

The market algorithm already has a function for taking losses into account. Implementation of implicit losses on the Skagerrak Interconnector will in practice mean that the current loss factor on the Skagerrak Interconnector will change from nil to a positive loss factor.

3. Method for calculating loss factor for the Skagerrak Interconnector

The Skagerrak Interconnector consists of four parallel HVDC cables in which the actual physical loss increases exponentially with the quantity transferred. The loss is unique for each cable, but is substantially greater for the two oldest cables. Both total quantity transferred and operating policy (how

[1] This does not apply to “NorNed” or “Baltic cable” where implicit loss handling has been implemented.

[2] Where, Statnett already has it implemented on NorNed, interconnector between Norway and Netherlands today.

the load is distributed on the four cables) will therefore affect the physical losses for the Skagerrak Interconnector.

However, the market algorithm does not accept non-linear losses, and the physical losses must be represented in the market algorithm by a linear loss factor. This is estimated on the basis of the following linear description of loss:

Loss = No-load loss + (Loss factor * |Flow|)

The so-called "no-load loss" is the loss arising without a flow on the interconnector. The reason for this is that the cables are "energised" even when there is no flow on them. However, the no-load loss is very small, and we will therefore implicitly include this element in the loss factor estimate by setting this at nil. The relationship between the linear description of losses and the actual losses is thus illustrated in Figure 1.

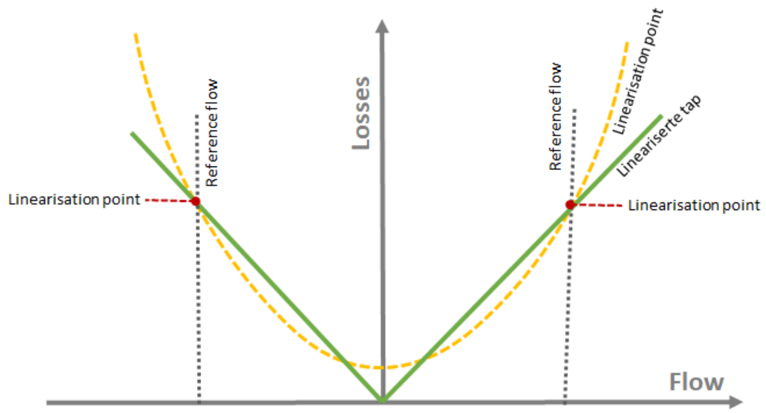

Figure 1 Relationship between actual and linearised losses

Losses is a function of flow, and thus the loss factor is also an input in the market clearance where the flow is determined. However, due to the linear nature of the applied loss factor, a reference flow for estimating the loss factor must be determined before we know the correct flow. An obvious question is therefore whether the loss factor should vary through the year by the hour, day, week or season. In this relation, we have conducted an analysis (See Appendix 1) which shows that such periodisation will only affect calculation of the loss factor to a very small extent. We will therefore use a fixed "annual" loss factor with annual adjustment. Market participants and the Danish and Norwegian NRA will be informed prior adjustment of loss factor. However, we will also consider the need for adjustment during the year if the circumstances so indicate. As a reference flow, we will use the annual median flow for all hours with positive flow. The choice is based on an analysis in which we assessed two different averages and two different median values. The analysis did not yield significant differences in resulting loss factor (See Appendix 1).

For the loss factor estimate itself, we have two methods available. One is a (fundamental) "Bottom Up" model, and the alternative is a (statistical) "Top Down" model. In the "Bottom Up" model, the physical losses are calculated for a given reference flow based on a complete description of the components in the Skagerrak Interconnector, including an updated operating policy. In the "Top Down" model, on the other hand, a statistical analysis of time series for measurement data (flow and losses) is used in the calculation. (Appendix 1 contains a detailed description of the two different models.)

The strength of the "Bottom Up" model is that it provides a precise estimate of losses for a given flow and a given operating policy. The disadvantage is that the result depends on a specific "Control setting" for the transmission installation (which in reality) may change over time. The advantage and disadvantage of the "Top Down" model are exactly the opposite. The model is less precise for a given flow and operating policy, but on the other hand it is independent of "Control Settings".

In our estimates of loss factor for the Skagerrak Interconnector, we have decided to use the "Bottom Up" model for the starting value, whereas we will later use the "Top Down" model in connection with adjustments. Based on the above description, we have (based on data from 2017) a reference flow for the Skagerrak Interconnector of 946 MW and a loss factor of 2.5 per cent. However, this calculation will be updated before implementation on the Skagerrak Interconnector and will then be based on the method described above.

4. Socio-economic consequences of implicit loss handling on the Skagerrak Interconnector

In the autumn of 2017, the Nordic TSOs completed an analysis of implicit loss handling for the HVDC interconnectors in the Nordic countries (See Appendix 2). The Skagerrak Interconnector was one of the interconnectors that was analysed at that time. A loss factor of 3.8 per cent was used, which represents the loss at full flow on the interconnector. The results which are further accounted for in this section are entirely based on the Nordic analysis report and thus based on a loss factor of 3.8 per cent. This is greater than what the method described in the preceding section recommends, which is exclusively because of the choice of reference flow.

While the actual net losses are non-linear, we have to formulate losses in the market algorithm as a linear function of flow. The losses will therefore never be represented entirely correctly in the market. However, because the TSO analysis is based in its entirety on a linear description of losses, it is impossible to determine the effect of this inaccuracy. However, the method for determining a loss factor presented in the preceding section is aimed at reducing the discrepancy between implicit and actual losses and will therefore contribute to reducing any loss of effect by using a linear loss description in the market algorithm.

Analysis method

The socio-economic analysis of the Skagerrak Interconnector was conducted in two steps.

1. The market effects from implementing implicit losses (3.8 per cent on the Skagerrak Interconnector) were studied through simulations over 16 months with actual market bids (February 2014 – May 2015). The simulations were conducted in the market algorithm "Euphemia", and the results have been normalised to apply to each individual year. (See Appendix 2 for a more detailed description of the analyses.)
2. Because the market does not see the physical effects on electrical losses of transmission, a statistical analysis was carried out of loss effect in the AC grid and the HVDC interconnectors. The physical losses were then priced with prices from the market simulations. (See Appendix 2 for a more detailed description.)

The total socio-economic effect from implementing implicit losses on the Skagerrak Interconnector will thus be given by:

$$\mathbf{\Delta W = \Delta Market\ gain - \Delta Loss\ costs}$$

In which:

ΔMarket gain = ΔPS + ΔCS + ΔCI **(Stage 1)**

ΔLoss costs = ΔAC + ΔDC **(Stage 2)**

Δ = Change
W = Socio-economic surplus
PS = Producer surplus
CS = Consumer surplus

CI = Congestion income
AC = Loss costs in the AC grid
DC = Loss costs in the HVDC grid

Because electrical losses are not part of the market algorithm, a loss factor in the market simulations will only increase the cost of transmission. We must therefore expect that the first stage in the analysis will result in a negative contribution to the socio-economic surplus whereas the gain in the form of reduced losses will arise in the second stage. Theoretically, the sum of Stages One and Two should result in a positive socio-economic result (correction of a negative external effect).

When implicit loss handling is introduced on the Skagerrak Interconnector, transmission between NO2 and DK1 will become more expensive. The power will thus find other routes in the grid, for example via Sweden. Implicit loss handling on the Skagerrak Interconnector will thus reduce the losses on the Skagerrak Interconnector but will result in increased losses in the AC grid and the other HVDC interconnectors in the area. However, the analyses take into account all such effects and price them according to the relevant bidding zone prices. The resulting change in loss costs we find in the analyses is thus the net effect on loss costs. A positive change in loss costs (lower loss costs) thus means that the positive effect on the Skagerrak Interconnector is greater than the negative effects in the AC grid and the other HVDC interconnectors.

Market effects

The market effects from implementing implicit losses on the Skagerrak Interconnector are shown in Figure 2 with results for the Nordic countries, Norway and Denmark in million EUR. As expected, we see that the market gain is negative for Norway, Denmark and the Nordic countries as a whole. However, in Norway a small, but positive, consumer surplus and a negative producer surplus arise. This is the reverse for Denmark. Nevertheless, we cannot conclude in general that Norwegian consumers will win and the producers will lose. There are two circumstances that will influence this.

Firstly, the distribution is a result of the price effects in question during the analysis period, where typically higher transport costs will benefit consumers on the export side and producers on the import side of a bottleneck. Distribution effects between consumers and producers will thus vary between years, where the predominant flow direction to a large extent will determine the distribution. In years with a power surplus in Norway, which we expect will be the norm, implicit loss handling will result in a somewhat lower Norwegian power price and will thus benefit Norwegian consumers. The opposite will be the case in years with power deficits.

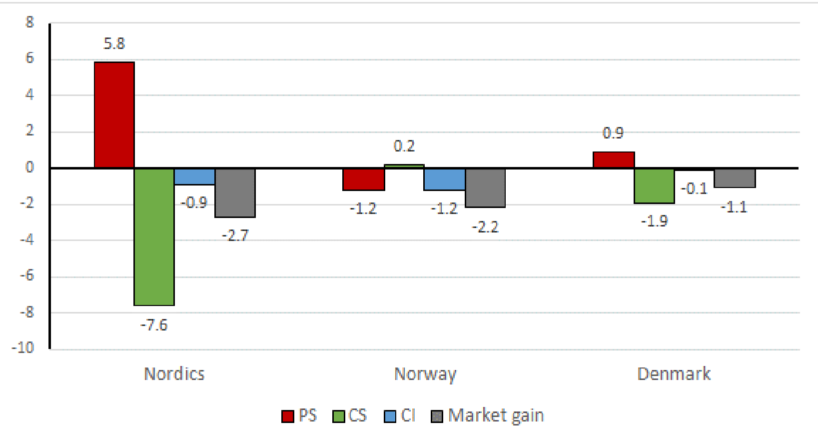

Figure 2 Annual market effect of implementing implicit losses on the Skagerrak Interconnector, in million EUR

Secondly, we must also take into account tariff effects. When the TSOs introduce implicit loss handling, they will no longer pay for the losses through market operations (purchases of losses). This will benefit tariff customers through lower tariffs for consumption. This will in turn compensate for any reductions in the consumer surplus to a greater extent than for the producer surplus. However, the latter element has not been analysed, and it is therefore not possible to determine the strength of the tariff effect.

Effects on flow and Grid losses

The loss costs consist of changes in losses in the AC grid and on HVDC interconnectors. When implicit loss handling is introduced on an HVDC interconnector, as mentioned earlier, the cost for transmission in the AC grid and on HVDC interconnectors will become relatively less expensive. We can therefore expect higher transmission losses and loss costs in the AC grid and on HVDC interconnectors. On the other hand, the total losses on the HVDC interconnectors, including Skagerrak, can be expected to be reduced. The total changes in loss costs in the AC grid and on the HVDC interconnectors from our analyses are shown in Figure 3. The total loss costs on the Norwegian and Danish HVDC interconnectors are substantially reduced, while we only have a slight increase in the loss costs in the AC grids.

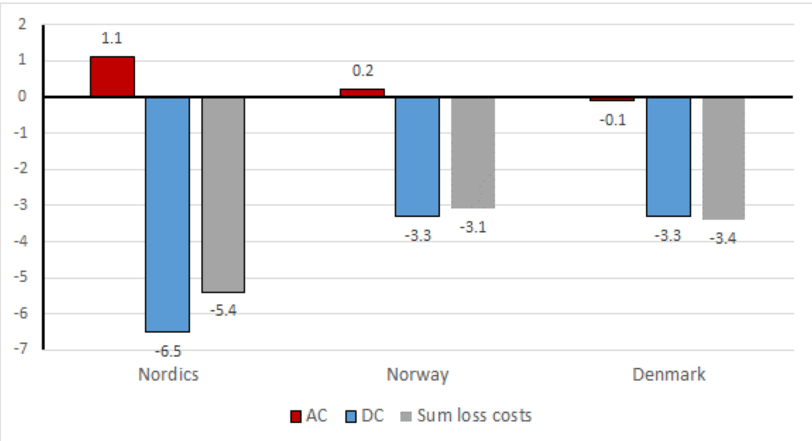

Figure 3 Annual change in loss costs in the AC and HVDC grid with implicit handling of losses on the Skagerrak Interconnector, million EUR

Total socio-economic result - Summary

As previously mentioned, the total socio-economic result consists of two parts, changes in market gain and changes in loss costs.

As expected, the market gain is negative, while the loss costs decrease. We thus find the total socio-economic gain from introducing implicit grid losses on the Skagerrak Interconnector by adding the results in Figure 2 and Figure 3. This is shown in Figure 4 where we see that the estimate yields an annual gain of EUR 0.9 million for Norway and EUR 2.9 million for Denmark from introducing implicit loss handling on the Skagerrak Interconnector. The reason for the gain being greatest for Denmark is that AC losses and trading income are more strongly affected in a negative direction in Norway than in Denmark during the period analysed.

Implicit loss handling on Skagerrak thus results in an expected socio-economic gain for Norway without significant negative issues for operational reliability in the AC grid.

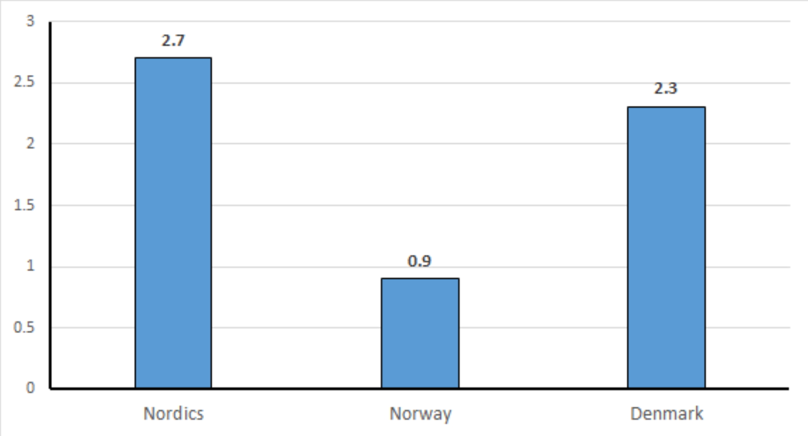

Figure 4 Annual socio-economic gain from implicit loss handling on Skagerrak, million EUR

Operating conditions

The loss costs in the AC grid are related to effects on both price and physical flow, and it is therefore necessary to ask whether the physical changes to flow in the AC grid might result in any operational issues. The most appropriate area to examine more closely as regards the AC grid is the interconnector between NO1 and SE3. The results for changes in flow on NO1-SE3 are shown in Figure 5. The first thing we notice is that the total flow on the interconnector increases by approximately 5 per cent. This is not in itself reason for operational concern as the interconnector usually has available capacity at times throughout the year.

However, a more appropriate measurement for the operating situation is whether increased flow results in a more difficult operating situation during high loads. We have sought to show this by looking at how large an increase we have in the number of hours with high flow, represented by the percentage increase in the number of hours with flow exceeding 90 per cent and 99 per cent of specified market capacity. What we see from the figure is that the annual number of hours with flow close to full capacity utilisation (over 99 per cent of market capacity) increases by 24 per cent. However, this is something we will also see as a variation during various years, for example because of the hydrological situation. Therefore, this is not in itself to be considered particularly problematic beyond what we see with respect to usual variation.

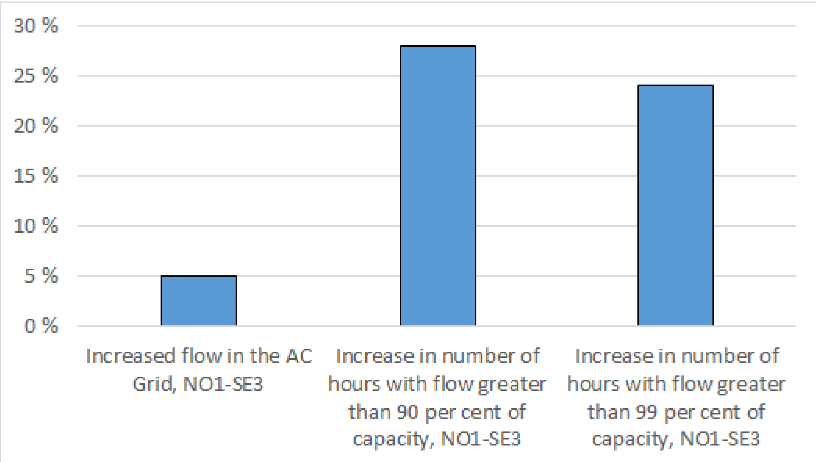

Figure 5 Changes in Flow in the AC grid as a result of implicit handling of losses on the Skagerrak Interconnector

Another question is whether during periods of full capacity utilisation on NO1-SE3 we might have an increased potential for physical overloads because of implicit handling of losses on Skagerrak. When there is full capacity utilisation on NO1-SE3, there will also be a large price difference between the two bidding zones. In such situations, there will also usually be a large price difference between NO2 and DK1, and implicit loss handling will thus hardly affect the flow on either the Skagerrak Interconnector or on the interconnector between NO1 and SE3. On the other hand, there will not be any flow on the Skagerrak Interconnector before a bottleneck has arisen at Konti-Skan and the Great-Belt Interconnector. However, the latter only applies until implicit loss handling is introduced on the two referenced HVDC interconnectors.

Seen as a whole, there is limited reasoning that implicit handling of losses on the Skagerrak Interconnector will result in an unacceptable reduction in operational reliability.

Change of flow on Danish Interconnectors

As described there is a positive welfare economic effect of implementing implicit grid loss on the Skagerrak interconnector. The effect in increased AC loss cost is outweighed by the decrease in HVDC-loss cost. The loss cost are an aggregate of the change in physical flow and the change in electricity price. Thereby the result could in theory be due to a high change in physical flow and a minor change in the electricity price difference. The results of the simulation of physical flow can be seen in the below Table 1.Table 1 Simulated change in flow on Danish Interconnectors in average over the period of the Common Nordic Analysis (February 2014- May 2015)

Interconnector	DK1-NO2	DK1-SE3	DK2-SE4	DK2-DE	DK1-DE	DK1-DK2
Change in flow	-19.6 %	9.3 %	7.2 %	0.1 %	-2.3 %	-4.8 %[3]

Table 1 Simulated change in flow on Danish Interconnectors in average over the period of the Common Nordic Analysis (February 2014- May 2015)

The above results indicate an increase in flow over the period of the Nordic Common Analysis, on the Swedish Interconnections, Konti-Skan and Øresund, whilst the flow on Kontek is unchanged. The connections West-Denmark to Germany and Great-Belt also have a decrease in flow of respectively 2,3 pct. and 4,8 pct.

The congestions that currently are visible on the Danish-Swedish interconnector, in part due to the restrictions of the West-Coast Corridor are regarded in the analysis, as the results are based on historical values, where the congestion due to the West-Coast Corridor also where apparent.

Electricity Price Convergence

The main reason for implementing implicit grid loss on the Skagerrak interconnector is the increase of effectivity of use of interconnector capacity and thus there should be no flow on an interconnector if the price-difference is smaller than the costs of transporting the Energy. Thereby, only in the rare

[3] Regrettably, the value for the Great-Belt interconnection is not included in the Nordic Common Analysis, however, is accessible in the underlying data.

cases when the price is zero in both bidding zones, will there be full price convergence on the interconnector with implicit grid loss implemented.

Nevertheless, the price convergence in itself is not a standard for efficiency and should thus not be of concern with regards to the decision of implementing implicit grid loss. Further, as an example, if Skagerrak is out of service, there is also the possibility that prices are convergent in the bidding zones NO2 and DK1 through flow from neighbouring bidding zones. However, this does not imply that the Skagerrak interconnector was used efficiently either.

The main aspect here should be the social economic surplus. Thus, Energinet and Statnett will in time communicate to market participants other measures to reflect the efficiency of markets and interconnector usage.

5. The Intraday market

The objective is to implement implicit loss handling in both the Spot and the Intraday markets. However, the functionality for handling implicit losses in the Intraday market has not yet been implemented in the Cross- Border Intraday Market (XBID), and there is reason to believe that this will come somewhat later than in the Spot market. We consider this a temporary problem as we expect that this interim period will only last a short time. XBID currently is implementing a proto-type, which will thereafter be translated into the actual solution. It is expected that the solution for implicit loss handling in XBID will be available in 2020.

It is conceivable that during this interim period the expected efficiency gain can be reduced through arbitrage for the Intraday market. However, because the losses in the Intraday market will be the same as in the Spot market, it will be impossible to come out worse than with the current handling of losses. In the worst case, there will be full arbitrage and thus no effect from implicit loss handling in the Spot market until the solution is activated in XBID. However, this is unlikely as the Intraday market is used mainly for handling balancing by the participants responsible for balancing. It is therefore expected that any arbitrage between the Spot and Intraday markets in the interim period will be moderate in any event, which is also supported by experiences from introducing implicit loss handling on the interconnector between Norway and the Netherlands (see detailed discussion in Appendix 3).

Furthermore, article 23 (3b) of CACM regarding “methodologies for operational security limits, contingencies and allocation constraints” states that “constraints intended to increase the economic surplus for single day-ahead or intraday coupling”, thereby an allocation constraint may be implemented if it increases the economic surplus of either single day-ahead or intraday coupling. In the interim period of implementing implicit grid loss on the Skagerrak interconnector the studies made by Statnett and Energinet and the rest of the Nordic TSOs indicate that the implementation of implicit grid loss on the Skagerrak interconnector will increase the economic surplus for the day-ahead market. Therefore, Energinet and Statnett conclude that the implementation of implicit grid loss in the day-ahead market prior to the intraday market is in line with the CACM regulation. And as stated above it should be noted that this is solely for an interim period until the intraday market solution for implicit grid loss is developed.

6. Balancing market

The current rules of the balancing market for upward and downward regulation encompass that upregulating bids are at a minimum the day-ahead market price, and for downward regulation the bid is at a maximum the day-ahead market price. Thus, in an example where there is export to Norway from Denmark, with a price of 400 DKK/MWh, the price in Norway would be 416 DKK/MWh (with implicit grid loss factor), assuming that the prices are equal without implicit grid loss. Thus the Danish upregulating bids are at 400 DKK/MWh, which would be first priority over the Norwegian bids at 416 DKK/MWh and for downward regulation the bids of 416 DKK/MWh in Norway would be prioritised over the price of Danish bids at 400 DKK/MWh. The point being that the current setup would lead to a more systematic difference between the choices of bids in the two bidding-zones. Yet, the supply curves are more likely not horizontal, which indicates that the effect is not expected to be significant.

Furthermore, the flow direction between Norway and Denmark changes throughout the year, therefore, it can be assumed that market participants are both affected, as the above described situation also occurs in opposite direction, if there is import to Denmark.

The Nordic TSOs are currently implementing a new balancing market, under Electricity Balancing Guideline (EB GL). The principal for the rules on the balancing market and methodology cannot solely be decided by Energinet and Statnett, as these are all TSOs decisions and all NRA approvals, cf. EB GL. For example, in the MARI implementation work, three options are being considered:

1. Losses are not considered
2. Losses are considered by looking at the marginal flow
3. Losses are considered taking into account the total flow from previous time frames.

Thus, the ongoing work in MARI include thorough analysis of the possibilities to implement implicit grid loss in the balancing market. The outcome of these, to ensure the best for the Danish and Norwegian Stakeholders can be affected by Energinet and Statnett, however it cannot be guaranteed. The development will also decide if there will be implicit grid loss in the balancing market.

7. Future development and Nordic Cooperation

Energinet and Statnett have the ambition to implement implicit grid loss on all their HVDC interconnectors in the future. Therefore, Energinet and Statnett aim to engage in close cooperation with the Nordic and adjacent TSOs to come to an agreement on possible future implementation on other HVDC interconnectors, to secure the social economic benefits, as presented in the Common Nordic Analyses on effects of implementing grid losses in the Nordic CCR.

8. Effect on other regions

At the time when Energinet and Statnett respectively decide to implement implicit grid loss with a neighbouring TSO, analysis of the potential consequences of flows due to implementing implicit grid loss on further interconnectors will be done. For the time being there are various reports on implicit grid-losses, which assess the effect on flow in the NWE area.

During the public consultation, Energinet received a comment concerning that trading energy between Norway and Denmark is likely to become more expensive than trading energy from Portugal to Denmark. However, such trades carry large AC loss-cost to be paid by TSOs via tariffs and shared in the ICT process by the TSOs. Implicit grid loss rather aims to correctly reflect the loss cost near or at its origins.

9. Relationship to European legislation

The objective with CACM is to arrange for an efficient European power market and efficient trading in power across bidding zone boundaries. Implicit loss handling will result in making trade over HVDC interconnectors more efficient and thereby contributing to the overall goal with CACM.

CACM will lay the groundwork for efficient power trading, and there are no circumstances in the arrangement, or in relevant methods developed under the arrangement, that create obstacles to implementing implicit loss handling on the Skagerrak Interconnector.

There are many developments in the electricity markets presently as the implementation of the CACM, EB GL and FCA guidelines proceeds. These have been forwarded as an argument for postponing implementing implicit grid losses as it is not one of the requirements of the regulations. However, the regulations aim to increase the efficiency of the electricity markets, which is also the case with implicit grid loss implementation. Since the beginning of the electricity markets, they have been in rapid development, and will be in future, therefore there is never an optimal timing of implementing a new methodology such as implicit grid loss. The method has been discussed and analysed several times for many years, which all indicate that there is a social-economic welfare gain to be achieved

The all Nordic TSO "Analyses on effects of implementing grid losses in the Nordic CCR" of 30 April 2018, showing a welfare benefit for the Nordic countries thereof, is in Energinets and Statnetts evaluation deemed sufficient meet the condition within Article 6(1)(c) of CCM for CCR Nordic, in demonstrating an EU-wide welfare economic benefit.

10.Implementation

Some work still remains before implicit handling of grid losses on the Skagerrak Interconnector can be implemented. The tasks include the following, with the current plan of implementation:

1. Identify changes necessary in existing agreements — May (2019)
2. Identify the need for changes in IT/Communications infrastructure — April-May (2019)
3. Implement changes in agreements and IT/Communications infrastructure — May-November (2019)
4. Functionality testing — November (2019)
5. "Go Live" — January (2020)

11. Appendixes

Appendix 1: Principles for calculating a loss factor for the Skagerrak connection

Appendix 2: Analyses on the effects of implementing implicit grid losses in the Nordic CCR

Appendix 3: Arbitrage between the day-ahead and intraday market