Splitting NO4 will probably increase grid utilization – with flow based market coupling

Statnett analyses indicate that congestions out of NO4 will increase in in the future. Splitting the NO4 in two will help us manage the bottlenecks efficiently. In this chapter, we explain this view.

Loop flows lead to inefficient usage of the lines

From NO4 there are connections to Middle Norway (NO3), Northern Sweden (SE1 and SE2) and a weak connection to Finland. The sum capacity of these lines are good. However, if one line is fully loaded before the others, full utilization of the capacity is impossible. When this happens, the generation cannot increase in NO4 even though there is available capacity on the remaining lines. The reason being that increased generation leads to increased load on all lines, including the one that was already fully loaded. In other words, the first line that is fully loaded limit all other lines out of NO4, since we cannot control the flow on each line. To avoid this we must limit the surplus by limiting the total capacity out of NO4. Another option, when possible, is to redispatch.

We expect this situation to become more frequent in the future, as the surplus in NO4 increases, partly due to increased wind power capacity. This happens because the capacity will more often be highly utilized, and because it can be even harder to predict the location of the generators that produce within the area. The challenge is mainly the interaction between the lines to Norway (NO3) and Sweden (SE1). Our simulation results show that the line to SE1 in many cases fill up first, leaving capacity to NO3 unused.

When we solve this type of congestion, it is challenging that the current NO4 bidding zone is such a large geographical area. This makes it necessary to predict the distribution of generation between the northern and southern parts of the area. Additionally it is challenging that we do not know where the generation will be located until close to the hour of operation. Altogether, this makes the current NO4 zone a poor tool for keeping the flow within safe limits of operation.

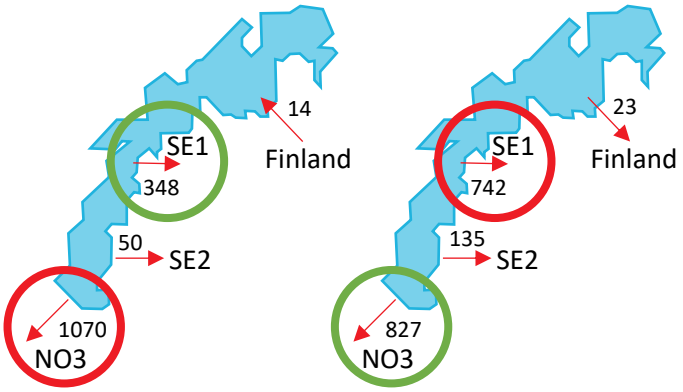

Figure 1:
Flow on 27. November 2018 01:21 (left) and 6. November 2018 06:17 (right).

There is available capacity on one line, while the other main connection is fully loaded. Increased capacity/export will increase loading on both lines, and this makes it difficult to give the market the free capacity.

Dividing into two bidding zones gives us more control in day ahead and better utilization overall

Results from our analysis shows us that we have better use of all the lines combined if we split NO4. We have not analyzed the case in enough detail to conclude exactly where the best place to split the zone is. However, it is evident that the benefit is greatest if we divided the area somewhere south of Ofoten – so that the line to Sweden (SE1) is in the northern area and the line to Middle Norway (NO3) in the southern. With the split here, our simulations show that we can utilize these two lines better and increase the total flow.

With two bidding zones, the market will know the distribution of generation and load between the northern and southern part of the current NO4 already from the bids in the day ahead market. Combined with flow based market clearing[1] (FBMC) we think this could improve the capacity with

[1] Flow Based Market Coupling (FBMC) is a system where physical flow is estimated in the calculation of exchange between bidding zones.

around 5-10 % without any new grid investments. The advantage of FBMC is that it considers physical flow directly in the market clearing and determines the market price based on this.

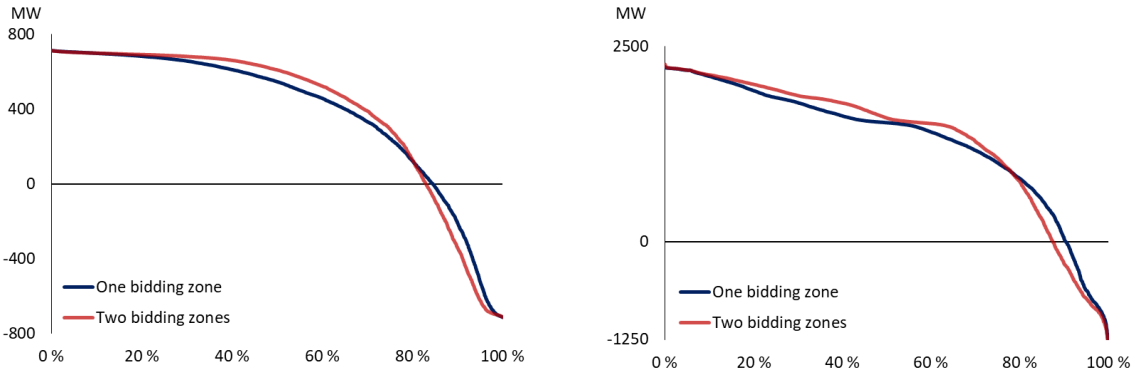

Figure 2: Simulated power flow on the line between NO4 and SE1 (left) and total flow out of NO4 (right), with one or two bidding zones. The capacity between NO4 and SE1 is limiting in many hours, and with NO4 split, the model is capable of increasing flow on the line/lines slightly in hours where they are already highly loaded. The result is from a simulation of 2025, and we use Flow Based Market Coupling (FBMC).

In an export situation, increased capacity out of the area reduces the probability of price collapse and maintains a more stable price. In other words, we can avoid situations where Northern Norway has much lower prices than the rest of Norway and Sweden.

Before FBMC is in place, it will be difficult to have efficient use of more bidding zones than we have today. Statnett would still have to estimate the balance and distribution of production in each zone before deciding the cross border capacity, and if there are weather changes or other surprising factors, these capacities might not be ideal.

Process of changing a bidding zone involves more TSOs and more analysis

This analysis is only partial and must not be read as a decision by Statnett to amend the bidding zone configuration. Statnett has published prognosis for bidding zones in 2013[2], 2015[3] and 2018[4]. In all these, Statnett wrote that we will review the bidding zone structure at the transition to FBMC. We consider a split of NO4 to be a natural topic for such a discussion. A split before the introduction of FBMC is unlikely, since it will be difficult to set the correct capacities manually outside the market clearing.

Higher flow out of NO4, which we think can be achieved with an area split, could have other consequences for operations, like more load on lines that are not limiting today, and more severe consequences of line failures. We need to analyze such possibilities in more detail.

Statnett will follow the guidelines set out in CACM[5] when making changes to bidding zones. CACM is a part of European Network Codes, which among other regulates how to change bidding zones. As a part of this, it sets requirements for analysis, documentation and involvement of other TSOs. Any change in the bidding zones – like a NO4 split – Statnett will do in compliance with CACM.

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[2] https://www.nordpoolgroup.com/message-center-container/newsroom/tso-news/2013/q4/No-532013-Prognosis-for-future-ElspotElbas-bidding-areas-in-Norway/

[3] https://www.nordpoolgroup.com/message-center-container/newsroom/tso-news/2015/q2/no.-152015---prognosis-for-future-elspotelbas-bidding-areas-in-norway/

[4] http://www.statnett.no/Global/Markedsmelding%20-%20Prognose%20for%20fremtidig%20elspotomr%C3%A5deinndeling%202018.pdf

[5] CACM – "Capacity Allocation & Congestion Management", (part of European Network Codes) https://electricity.network-codes.eu/network_codes/cacm/