



NordLink



Information session for
market participants

19th November 2020

TenneT & Statnett

Start	End	Description
09:00	09:10	Welcome & Introduction
09:10	09:30	Project overview (incl. movie)
09:30	10:00	Market integration of NordLink <ul style="list-style-type: none"> • Day Ahead, Intraday and Long-Term • Fall back for Day Ahead and Intraday (Shadow Auctions) • Implicit losses • Countertrade/Redispatch • Outage handling • Balancing (MAR/PICASSO)
10:00	10:10	Regulatory framework
10:10	10:50	NordLink capacity <ul style="list-style-type: none"> • TenneT: <ul style="list-style-type: none"> • Capacity calculation and how to deal with the German Action plan • Light SPAIC results (Standard Procedure for Assessing the Impact of Changes) • Statnett: <ul style="list-style-type: none"> • Capacity calculation and NO2 grid situation • Ramping restrictions
10:50	11:00	Break
11:00	12:00	Question round

<https://www.youtube.com/watch?v=ig5hSxjnhnM>

German-Norwegian co-operation

Statnett

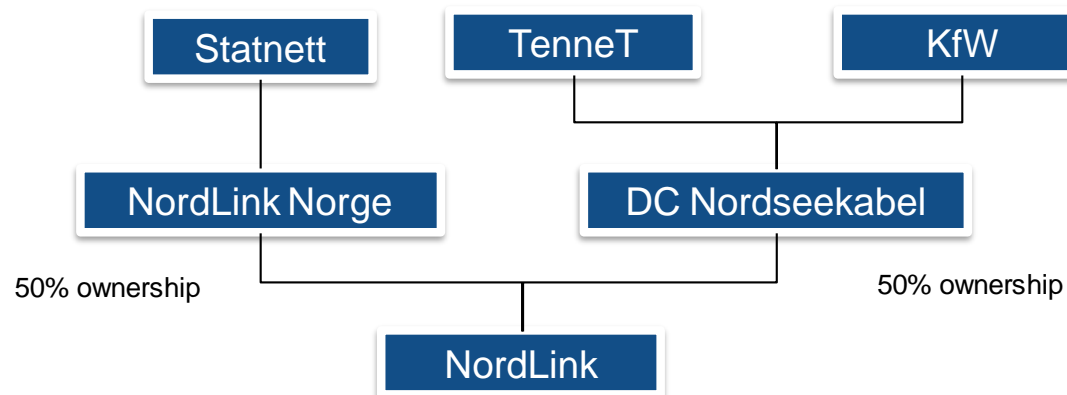
- Norwegian TSO, owner and operator of the Norwegian grid, including interconnectors.

TenneT
Taking power further

- Dutch and German TSO, owns and operates grids at connection points.

KfW
Bank aus Verantwortung

- Government owned investment bank, active in financing energy transition projects.



Facts and figures

■ Connection

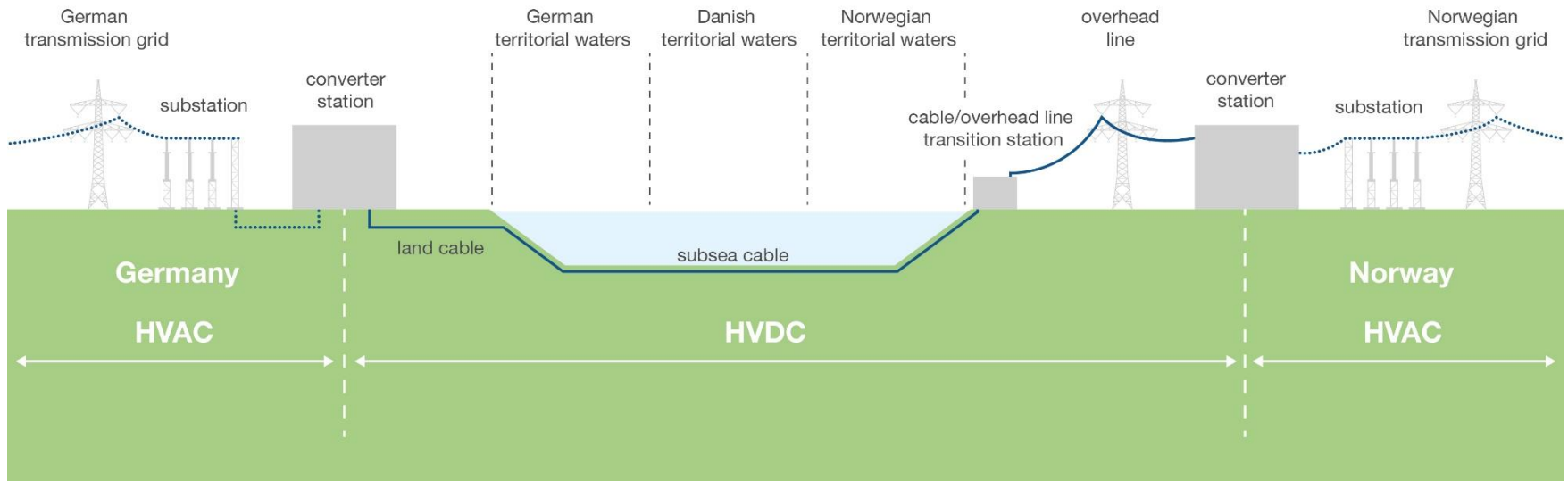
623 km grid connection system
 onshore NO: 53 km overhead line
 offshore: 516 km subsea cable
 onshore DE: 54 km land cable

■ Grid connection points

substations: Wilster (DE) and
 Tonstad (NO)

■ Technical details

1,400 MW, ± 525 kV, bi-pole HVDC



NordLink - Norway



NordLink - Germany



Exchange of green energy

NordLink will...

facilitate European Market integration

stabilize electricity prices and facilitate a more predictable energy market

add welfare to the society

For this we need to

integrate NordLink into European day-ahead and intraday markets

ensure a reliable, safe and efficient operation of NordLink

respect the regulatory and legal framework

Up to 1.400 MW

Up to 1.400 MW

Day-Ahead, Intraday, Long-Term

- NordLink has 1400 MW receiving end capacity
- Available day-ahead cross-border capacity is the outcome of TenneT's and Statnett's capacity calculation.
- Un-allocated capacity on the day-ahead market will be made available to the intraday-market (in accordance with intraday capacity calculation).
- NordLink will be integrated into the Multi Regional Coupling process (MRC) for day-ahead and cross-border intraday (XBID) process for Intraday.
- Long-Term Transmission Rights will not be offered from go-live.
- 1st December 2020 shall be the first trading day. First energy flow shall then be from 2nd December 2020 0:00 onwards. This is of course depending on successful completion of the transmission test phase.
- Operation will start with a „start-up period“ (gradually increase capacity but guaranteeing minimum capacities). Publication on how this will look like follows as soon as this is finally determined.

Fall-back Day-ahead

- In case of a decoupling situation in the Day-ahead market, cross-zonal capacities will be allocated in shadow auctions.
- Shadow auctions will be performed by JAO on behalf of TSOs (business as usual).
- All Market participants need to register at jao.eu.
- First time registration:
 - Participation Agreement required
- Already registered market participants:
 - Amendment to Participation Agreement required in order to include NordLink
- Please note that shadow auctions will allocate capacities only
 - In case of shadow auctions, successful bidders need to separately submit their cross-border schedules to the TSOs

Implicit losses

- On NordLink implicit loss handling will be applied.
- This means that flow will only be allocated on the interconnector if the value of trading power exceeds the cost of the losses when transmitting the power. The traded power in the sending end of the interconnector will include the amount of losses.
- NordLink has a loss factor of **3,1 %** (with sending end as reference)
- Implicit loss handling will be applied in the Day-Ahead market coupling from go-live of NordLink.
- As soon as implicit losses are implemented in the Intraday market coupling, it shall also be applied there.

Countertrade

- Statnett and TenneT are going to implement countertrading for NordLink from 2022 onwards to secure stable grid operation.
- A joint feasibility study was conducted that suggests bilateral TSO-TSO countertrading in conjunction with both TSOs trading at their local intraday markets.
- Functional description and high-level procedures have been already developed.
- The development of detailed operational procedures and IT requirements as well as contracting and regulatory approval are planned for 2021.
- Following successful implementation and testing the initial operation is planned for beginning of 2022.
- From start of operation countertrading will be possible in emergency situations only.

Outage procedure

When there is a failure/outage on NordLink:

- capacity that was already allocated day-ahead will not be affected
- TSOs will take necessary measures to compensate this energetically for the remainder of the day
- capacity may have to be reduced/set to zero for the next day/for the duration of the outage

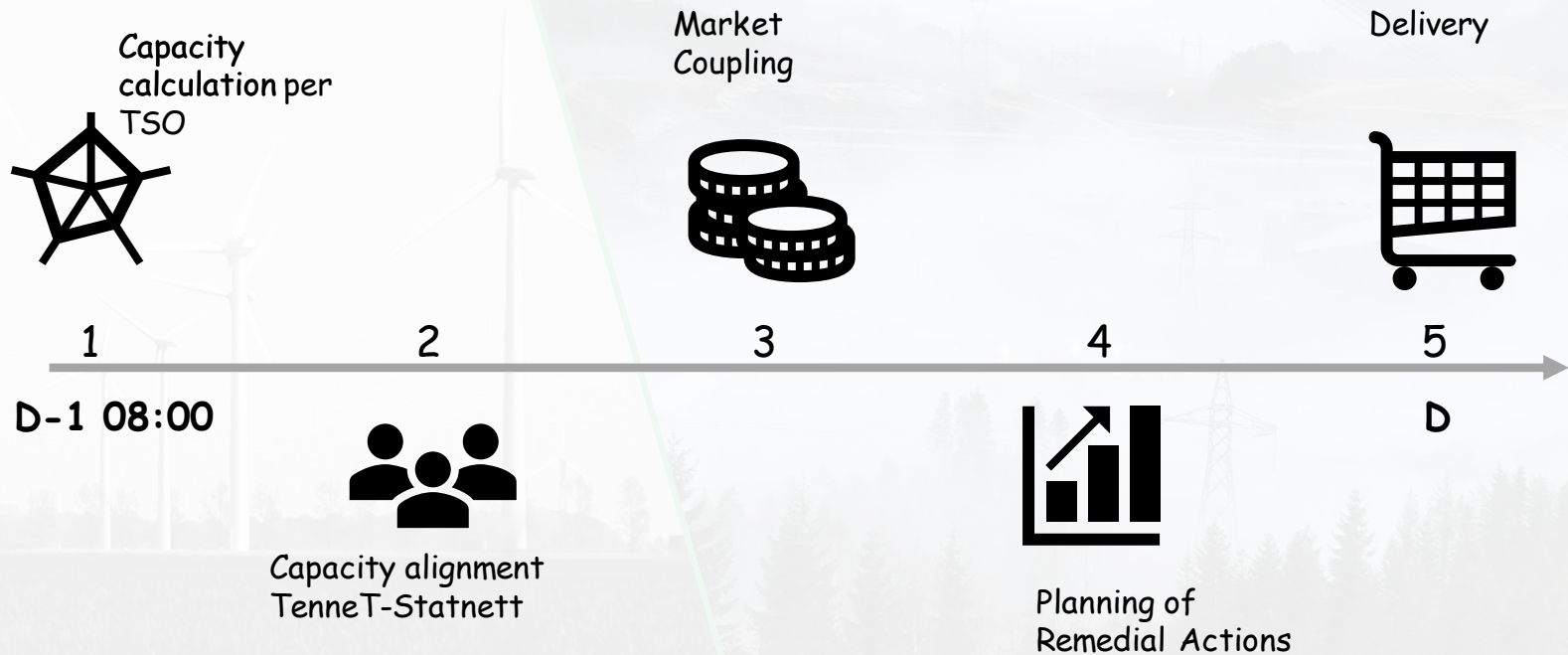
Balancing

- NordLink will participate in the following balancing platforms when these become available for cross-border trading (acc. to accession plan):
 - MARI for manual frequency restoration reserves (mFRR)
 - PICASSO for automatic frequency restoration reserves (aFRR)

NordLink regulatory framework

- Network codes are going to be implemented in Norway
 - Final implementation date not known
- Norway, as an EEA country, is participating in the Internal European Energy Market in the same way as EU Member States
- CCR Hansa admission procedure
 - Borders included in CCR Hansa: DK1/DE, DK2/DE, SE4/PL, NL/DK
 - Following Norwegian adaptation of CACM the bidding zone borders NO2-DE (NordLink) and NO2-NL (NorNed) will be allocated to CCR Hansa
 - All TSO/NRA approval for membership, followed by regional TSO/NRA process for amendments/adding NordLink to methodology documents
- Operation will start without CCR framework formally in place for NordLink
 - Operational procedures implemented in line with CCR Hansa methodologies
 - Methodologies to be applied for NordLink are approved by the regulators in Norway and Germany

Day-ahead Capacity calculation in a nutshell



D-1 Day before delivery day D Delivery Day

Fact sheet



For start of operations of NordLink an interim capacity calculation method is required until the approved capacity calculation methodology for the capacity calculation region Hansa is implemented.



Germany shall apply the Clean Energy Package.

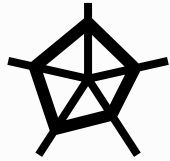


The capacity calculation on the German side includes the obligation of the German Action Plan to offer a certain percentage of capacity per critical network element for cross-border trades. This is a minimum only.

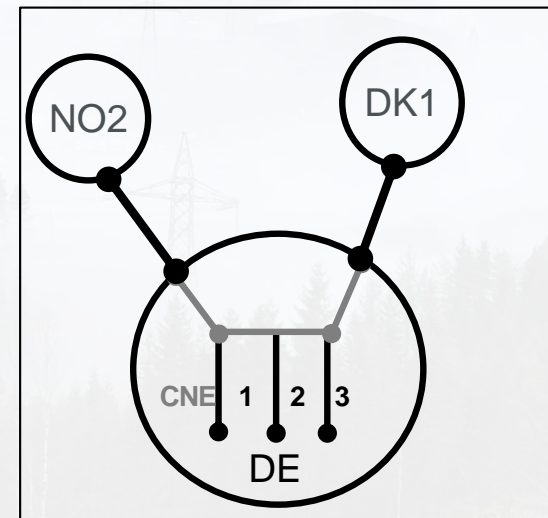
year	% of capacity per critical network element
2020	0
2021	11,7
2022	23,3
2023	35
2024	46,7
2025	58,3
from 31.12 2025 onwards	70

The table shows the linear trajectory of these percentages to be applied on the critical network elements for NordLink from start of commercial operation in December 2020 until 70% are reached by 31.12.2025.

Method



- Basis for the capacity calculation method is a common grid model including critical network elements with contingencies (CNECs).
 - CNECs are network elements within the TSO's grid which have a significant impact on cross-border flows.
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- For NordLink and the German-Danish border the same CNECs are relevant, considering the individual minimum margins.
 - Minimum margins are a share of the maximum permissible flow of the CNEC.
 - Following the German Action Plan the minimum margins have to be ensured.
 - The available margin on these CNECs is shared proportionally between NordLink and the German-Danish border.



Capacity assessment

- In daily operation, each TSO makes a capacity calculation for its own grid. This means, that Statnett's calculations do not reflect German grid restrictions while at the same time TenneT's calculations do not reflect Norwegian grid restrictions.
- The hourly capacities that will be offered to the market will be the lowest of the values given (i.e. the lowest trading capacity given the restrictions on each side of the interconnector).
- In order to give an outlook on available capacities from start of go-live both TenneT and Statnett have made an assessment.
- The figures below represent the outcome of this assessment.

Forecast capacity

- TenneT forecast for 2022:
 - Full 1,400 MW import (NO>DE) capacity in 1,300 hours
 - Average import capacity of 853 MW
 - Full 1,400 MW export (DE>NO) capacity in 4,100 hours
 - Average export capacity of 1,176 MW

Impact on CWE (Light SPAIC)

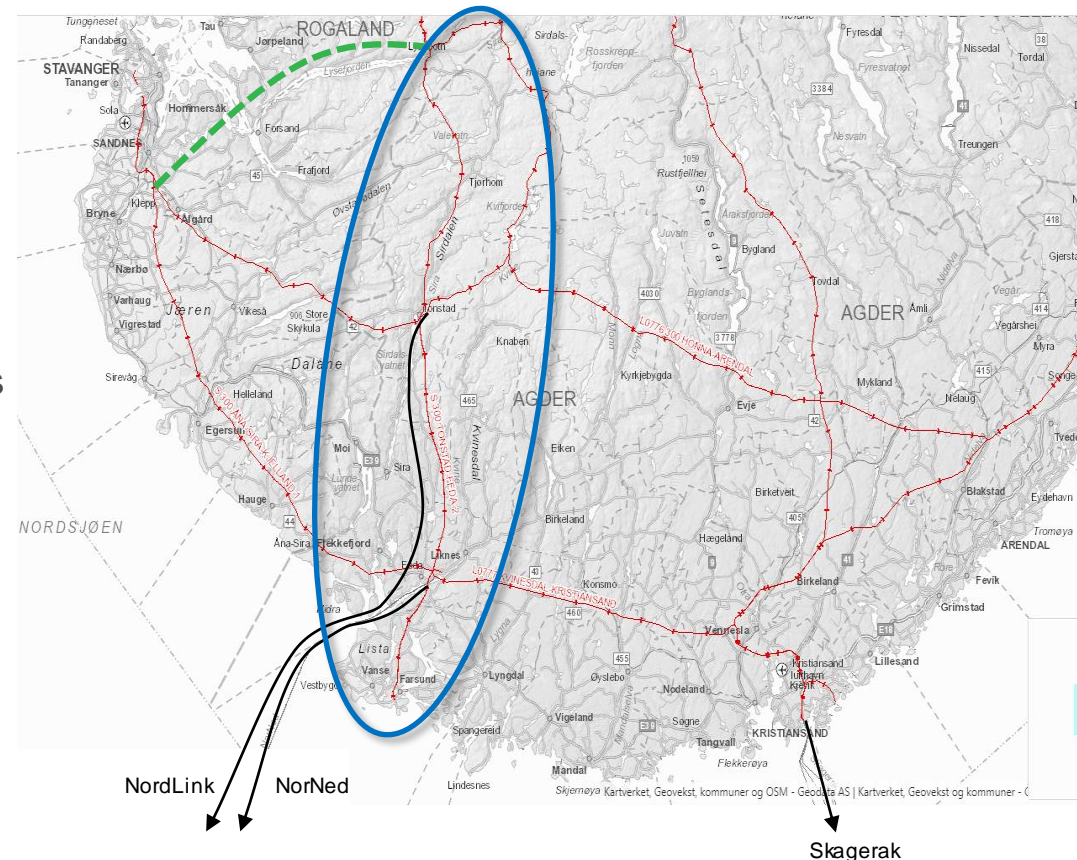
- Light SPAIC (Standard Procedure for Assessing the Impact of Changes) of CWE in order to assess the impact on CWE Flow-Based parameters
 - Calculation of Flow-Based parameters for 7 historical days
 - Both full export and full import scenarios of NordLink have been considered
 - Results will be published on JAO (jao.eu)
- Results for maximum import and export capabilities of CWE's bidding zone
 - minor impact on min/max net position of CWE's bidding zones
 - mostly affected are DE/LU and NL with an average of less than 2 %

Min/max net position indicator

- Since the cross border capacities in flow-based capacity calculation are dependent from each other, the min/max net position indicator is commonly used to assess the flow-based parameters and to compare them.
- The maximum possible import and export per bidding zone is calculated for each bidding zone separately, while the other bidding zones are adjusted to reach the maximum.
 - The maxima can not be reached simultaneously by all bidding zones
 - CWE net positions are covering only exchanges among CWE bidding zones

Statnett capacity calculation and grid reinforcements

- A large grid reinforcement program started in parallel with the new the cable projects. Due to licensing process it was not expected that all grid reinforcement was finished at the same time as the cables.
- **Western corridor** project is upgrading the network from 300 to 420 kV. Final parts will be finished in October 2021. Planned outages will affect the capacities on the HVDC connections February – October 2021
- A new 420 kV line **Lyse-Fagrafjell** will remove the need for capacity reduction when the network is intact, and reduce the capacity reductions during outages. This line will be in operation in 2023/24 and is the last planned reinforcement in the 420 kV network in NO2.



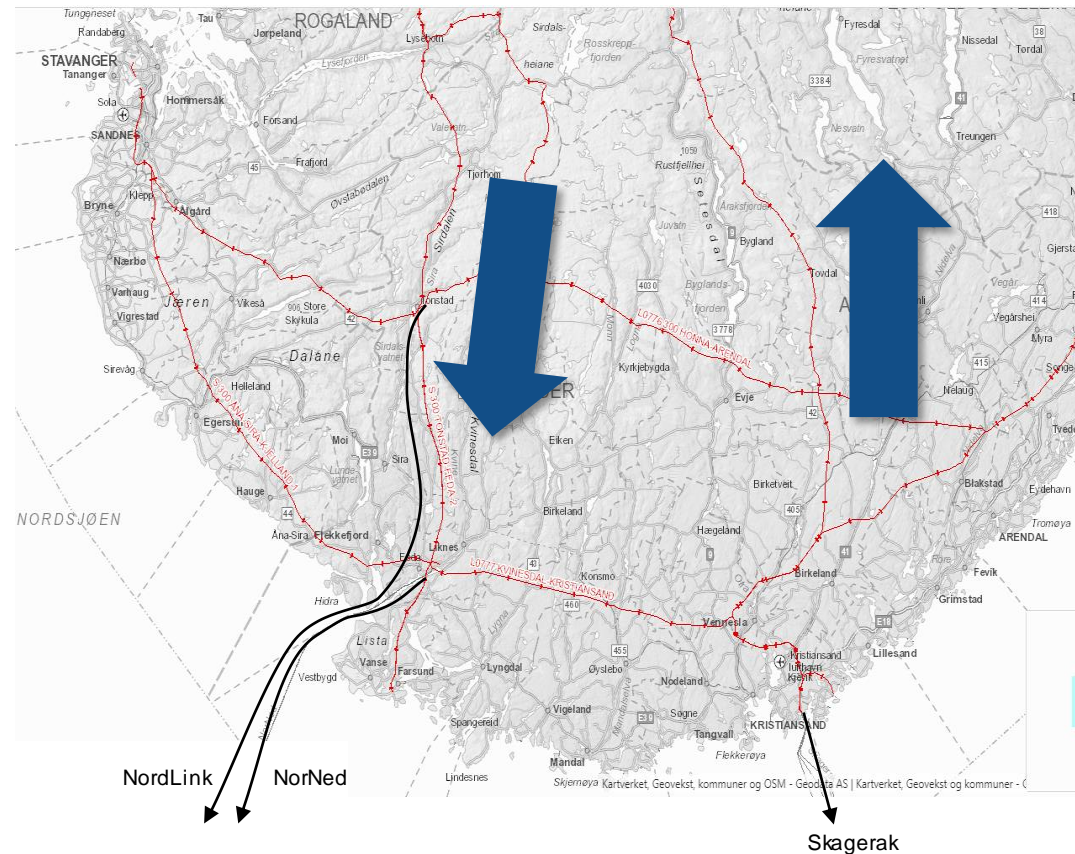
Capacity Calculation Methodology

- The capacity reductions on each HVDC connection is based on socio-economic analyses, taking into account both **the effect of the reductions** on actual network constraints and **the expected price differences** between NO2 and NL, DE and DK1.
- Calculations with dynamic simulation tool (Aristo) taking into account
 - "Spring" and "Autumn" cases for local generation and demand
 - Year-ahead outage plans for all relevant projects and grid elements
 - Installed Emergency Power Control (EPC) functionality
- Initially, a net capacity into and out of NO2 is calculated.
- Distribution between individual HVDC connections based on effect on actual constraints and expected price differences.
- Capacity calculations will be updated closer to the start of the outage, or when new outage plans are submitted.

Capacity constraints in NO2

- **During high export** it will be most efficient to reduce the flow on NordLink and NorNed to handle grid constraints in NO2.
- **During high imports**, it will be most efficient to reduce the flow on Skagerak from DK1
- Average NordLink capacity in 2021:
 - Average export: **1140 / 917 MW¹**
 - Average import: **1377 / 1363 MW²**

1) Assuming high vs low generation in NO2
 2) Assuming high vs low load in NO2



Forecast capacity

- **Statnett forecast for 2021:**

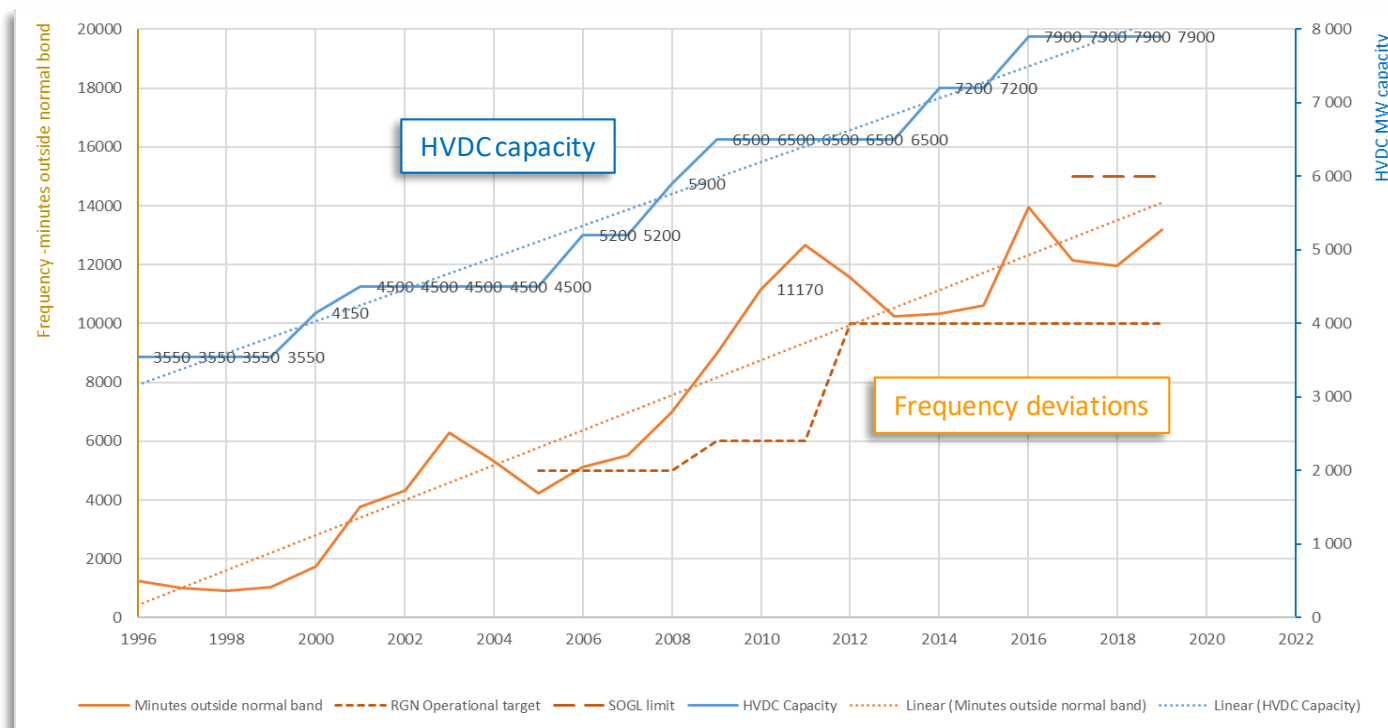
- NordLink will have an average northbound capacity of 1,363–1,377 MW and southbound capacity of 917–1,140 MW.

- **TenneT forecast for 2022:**

- Full 1,400 MW southbound capacity in 1,300 hours
- Average southbound capacity of 853 MW
- Full 1,400 MW northbound capacity in 4,100 hours
- Average northbound capacity of 1,176 MW

Ramping challenge in the Nordic SA

The Nordic TSOs have agreed a ramping limit of **600 MW/hour** on individual HVDC interconnectors. Each new IC has implemented the same limit, while frequency quality has deteriorated.



Ramping rules for NordLink

- *Our ambition is to increase ramping to 600 MW/h during Trial Operation, provided that given quality criteria are not violated*
- In addition to frequency deviations, a main challenge is to handle the large changes in flow around hour shifts due to HVDC ramping. It is necessary to gradually build experience with the new interconnectors.
- *NordLink will therefore have a ramping limit of **300 MW/h** in Day-Ahead and Intraday from start of Trial Operation.*
- Based on a set of quality criteria, Statnett will evaluate how fast ramping can increase during Trial Operation.
 - Number and duration of frequency deviations
 - Number and duration of flow limit violations
- A more enduring solution is to implement a sum restriction for ramping in NO2 in the market coupling in combination with less restrictive individual restrictions, but this will not be available for NordLink go-live



Statnett |  TENNET | KfW

NordLink

Thanks for your
attention!

Back-up

Impact on CWE (Light SPAIC)

Quantiles of the difference in minimum and maximum netposition for NordLink import (NO>DE) and export (DE>NO) scenario

