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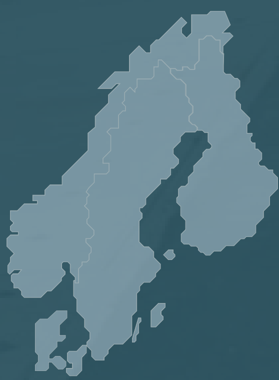
Nordic Grid Development Plan 2017



June 2017

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Content

1 Introduction

The Nordic council of ministers tasked in December 2016 the Nordic TSO's with presenting a Nordic Grid Development Plan 2017. This Nordic Grid Development Plan describes the ongoing and future investments in the Nordic grid. The main focus of the development plan is to communicate the status of individual projects and identify corridors for further analysis.

Transmission capacity plays a key role in addressing the future challenges of the power system. Adequate transmission capacity allows for cost-effective utilization of power, ensures access to generation capacity, enables exchanging system services, and is the key for a well-integrated market. Strong transmission networks are a prerequisite for a cost-efficient transition towards a green power system.

A large amount of new renewable generation is expected to be built, especially in the northern parts of Sweden and Finland. This will significantly increase the north-south flows in the Nordic transmission grid. Both existing and potential new transmission lines will transmit the energy surplus in the north to the consumption centres in the south. In addition to new lines inside the Nordic countries, planned new interconnectors will strengthen the integration of power markets towards Continental Europe and UK.

The Nordic Grid Development Plan 2017 describes drivers for further development of the Nordic power system. Based on the drivers presented as well as internal studies, the Nordic TSOs see a need for further investigations of several cross-border corridors in the Nordic system (Norway-Denmark, Norway-Sweden, Norway-Finland, Sweden-Finland, Sweden-Denmark). The intention is to present these investigations in the next Nordic Grid Development Plan 2019.

2

The Nordic grid planning process

The Nordic cooperation regarding grid development, which previously was done within Nordel, is now primarily performed under ENTSO-E's organization. The latest ENTSO-E Regional Investment Plans were published in 2015. They listed possible future project candidates that were presented in the 2016 Ten Year Network Development Plan (TYNDP 2016). New Regional Investment plans are planned to be published late 2017.

The Nordic TSOs take an active part in the common regional planning done within ENTSO-E's regional groups Baltic Sea and North Sea, but also cooperate on grid planning issues on Nordic level. In 2014 Nordic TSOs re-established a Nordic planning group (NPG) in order to ensure continuous Nordic focus on regional transmission grid planning.

The Nordic TSOs also cooperate on creating joint scenarios used in studies of future transmission system needs. These studies are performed within ENTSO-E as well as bilaterally between Nordic TSO when further evaluating possible projects between the Nordic countries.

The final decision on which projects to realise is taken by each TSO and presented in the national grid development plans. The cooperation on scenarios and joint planning issues ensures that there is a consistency between the projects presented in the national plans and how they contribute to solve the Nordic and European grid development challenges. The common goal of the Nordic TSOs is to even further coordinate Nordic system planning activities.

The status of Nordic grid development has been reported to the Nordic council of ministers in 2012 and 2014. In 2016, focus was shifted from grid planning to system planning to also include operational and market issues. The report "Challenges and Opportunities for the Nordic Power System" reports on the issues facing the Nordic system in the future, following expected changes in production and consumption. While a lot of focus is put on these system issues and how to handle them with market and operational adaptions, grid reinforcements are still needed. The transfer capacity within and between different market areas makes the foundation for both energy trade and for an efficient use of new and existing system services. As an example, since the last report Svenska kraftnät and Fingrid have jointly decided to start implementation work on the third AC line that has been studied for a long time. The line will increase trading capacity and the possibility to exchange system services as well as increase the power adequacy in Finland.

3

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Regional drivers for grid development

The European power system is undergoing a fundamental change in how electricity is generated and used as well as on a political level. Conventional thermal power generation is being phased out and replaced with intermittent renewal power production with different technical characteristics but also at new locations. Electricity is also replacing fossil fuels in many areas of use and has an even more vital role in today's society than ever before. On the political level, there is a strong will to form a more closely coupled European Energy Union. These changes cause many challenges and opportunities for the Nordic power system and their impact on Nordic grid development is presented as a number of drivers, or focus areas, for the Baltic Sea region that all have an impact on the Nordic countries.

Focus area A: Further integration between the Nordic countries and the Continent/UK

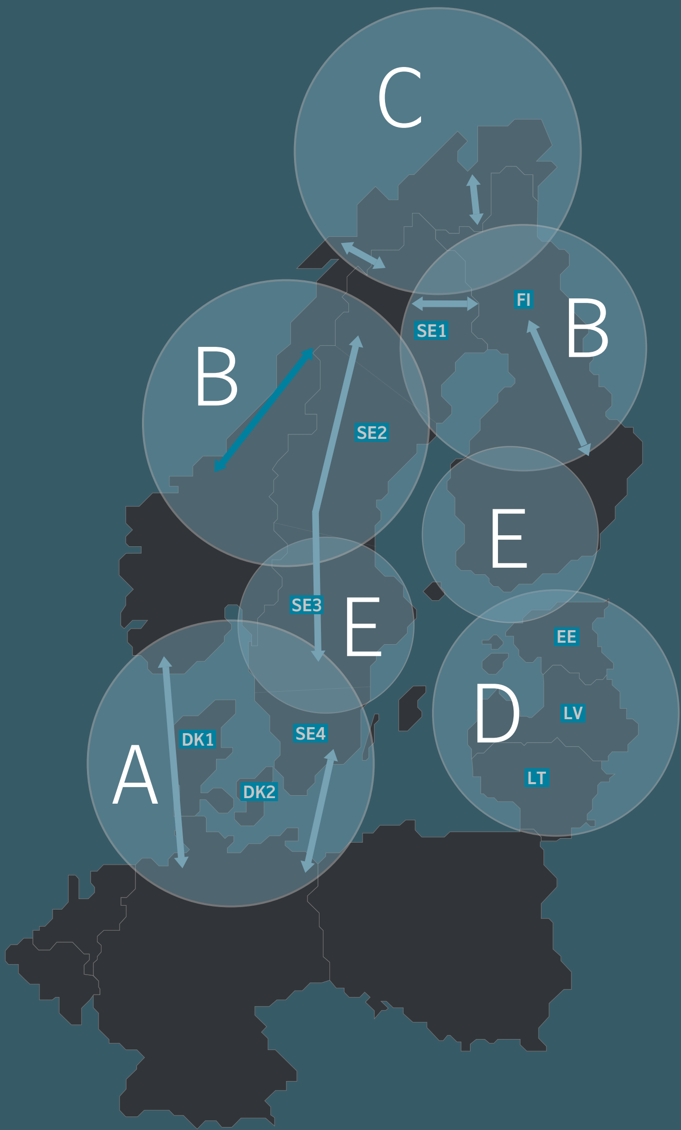
The Nordic system is likely to increase the annual energy surplus (even if some nuclear is decommissioned), which makes it beneficial to strengthen the capacity between the Nordic countries and UK/Continental Europe. This increases market integration as well as it increases the value creation of renewables. In addition, for daily regulation purposes, it will be beneficial to further connect the Nordic hydro-based system to the thermally based continental and wind based Danish system, especially when large amounts of renewables are connected to the continental system.

Focus area B: Integration of renewables and North south flows

Based on the political goals of reduced CO_2-emissions and based on the cost development of wind and solar, further integration of renewables is expected in the Nordic countries.

New interconnectors to the continent/UK/Baltic States in combination with substantial amounts of new renewable generation capacity is increasing the need to strengthen the transmission capacities in the north-south direction in Sweden, Norway, Finland and Denmark. In addition, nuclear and thermal plants are expected to be decommissioned in both southern Sweden and Finland which further increases the demand for capacity in the north-south direction.

Map of focus areas



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Regional drivers for grid development

Focus area C: New consumption

Depending on location and size, new electrical consumption may also trigger the need for grid investments. In the far north, the establishment of new power intensive industries such as mines, or the shift from fossil fuel to electricity in the petroleum industry, could create a need for substantial reinforcements. The general trend with electrical transportation, consumption increase in the larger cities etc. will also put focus on how to secure the supply.

Focus area D: Baltic integration

Based on energy security the Baltic States aim to de-synchronize from the Russian system. Based on an agreement between the involved BEMIP-Member States, synchronization with the Continental system is the preferred alternative for the Baltic system. The Baltic-Continental synchronization and other market based changes will lead to a potential change in the north-south-flow (Sweden/Finland-Baltic-Poland) which will have to be further investigated.

Focus area E: Future for the thermal and nuclear power

A substantial proportion of thermal and nuclear power plants, especially in Sweden but also in Finland, are expected to be decommissioned in the 2030 horizon. This would lead to an increased system adequacy risk. In Finland, Olkiluoto 3 will be taken into operation before any older nuclear plant is decommissioned and Fennovoima is planning to build a new NPP Hanhikivi 1. Realisation of the Hanhikivi 1 NPP would keep the nuclear production in Finland on the pre-decommissioning level, but it will require grid investments, as it is planned to be built at a different location than existing NPP's. Nuclear power has many important features in today's system, and a phase out will require new generation capacity, grid development, and further development of system services.

3.1 Reinvestments

Additional to the grid reinforcements in response to the grid development drivers, there is also an increasing need for reinvestment in the grids in the Nordic region. A large part of the transmission grids was built during the 1950s and 1960s. Reinvesting by replacement of old lines and substations with new, often with higher capacity, has already started, but the need for reinvestment will be a long-term requirement.

4

Status of Nordic projects

4.1 Nordic investments

The regional drivers for grid development have led to a very substantial increase in the grid investments carried out by the Nordic TSO's. The investment levels are at a historically high level and are foreseen to be so also in the coming years. In total, the Nordic TSOs plan to invest more than €15 billion until 2025.

4.2 Previous Nordic reinforcements

The Nordic TSO:s have in the last ten years through common planning increased the internal Nordic transmission capacity substantially by taking into operation a number of new internal reinforcements. Among them are Nea - Järpströmmen (2009), Great – Belt (2010), Fenno-Skan 2 (2014) and Skagerrak 4 (2014). These have been reported on in more detail in earlier Nordic grid plans.

4.3 Status of projects in the Nordic area

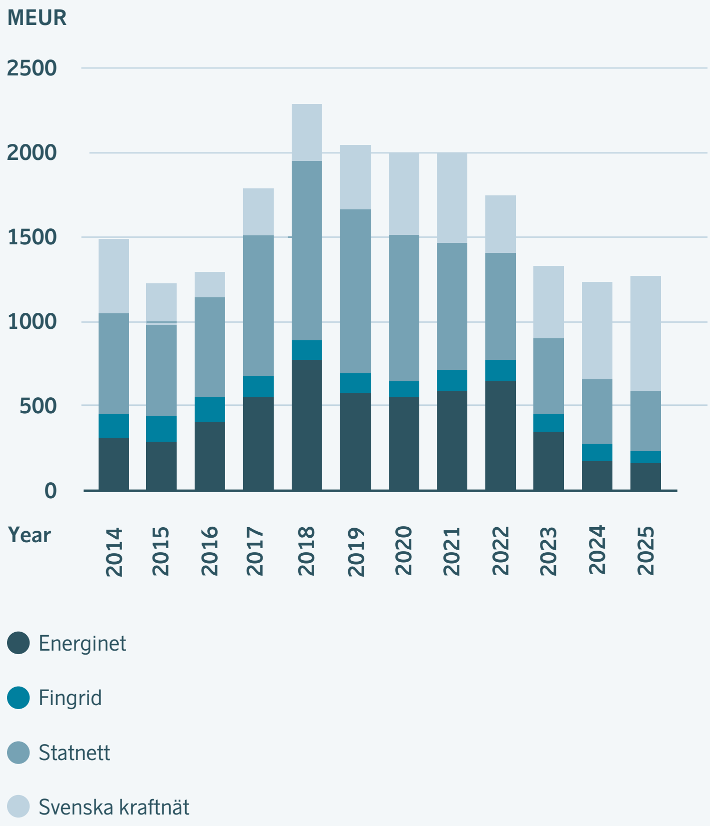
The status of different projects in the Nordic area are reported in this section as:

- "Taken into operation", meaning that the project has been taken into operation since the reporting of status in the Nordic Grid Development Plan 2014
- "Under construction/Decided", meaning that a final investment decision has been taken and the projects construction phase has started or will start shortly
- "Planned/Under consideration", meaning that the project has yet to be finally decided and that it is in one of various phases of studies or that the process of seeking necessary permits have started

In the reporting the projects have been categorised as: *National projects of Nordic importance, Cross border projects within the Nordic Area, Interconnectors to other synchronous areas*

Some of the projects have a reference to PCI-status. This is a status given by the European Commission to projects that have been deemed to be a Project of Common Interest to the European Union. The current label is valid for 2016-17 and a new application procedure for the period of 2018-19 has just started. A reference is also given to whether a current PCI-project has re-applied or not.

Total investments by the Nordic TSOs



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Status of Nordic projects

4.3.1 National projects of Nordic importance

Each Nordic TSO has a large number of internal grid investments including reinvestments. Some of these investments have a more direct impact on the Nordic and European system as they are needed to use the cross border interconnectors efficiently. The most important internal investments are listed below.

4 Finland

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The grid development in Finland is characterised by several projects in the north-south-direction and upgrade projects in Southern Finland around the main consumption areas. The north-south reinforcements will facilitate new renewables and allow further integration with Sweden securing the national supply while the projects in Southern Finland are important for local security of supply and internal capacity availability for full utilization of HVDC connections.

	Project	Status	Description
F1	**Hikiä-Forssa**	Taken into operation 2016	New 400 kV AC single circuit OHL of 78 km between substations Hikiä and Forssa.
F2	**North-South reinforcements stage 1**	Taken into operation 2014-2016	New 400 kV AC single circuit OHLs of 111 km between substations Ulvila-Kristinestad, 212 km between substations Hirvisuo-Jylkkä-Pyhänselkä. New series compensation in Hirvisuo. Projects allowed to connect new wind power generation and increased transmission capacity in P1 cross section with ~700 MW.
F3	**Lieto-Forssa**	Under construction Expected in operation 2018	New 400 kV AC single circuit OHL of 67 km between substations Lieto and Forssa.
F4	**Hikiä-Orimattila**	Under construction Expected in operation 2019	New 400 kV AC single circuit OHL of 70 km between substations Hikiä and Orimattila.
F5	**North-South reinforcements P1 stage 2**	Planned/Under consideration Seeking permission Expected in operation 2022	New 400 kV AC single circuit OHL of 300 km between Pyhänselkä and Petäjävesi. The line will be series compensated. Built to increase the north-south transmission capacity thus enabling the integration of new renewable, new connection to Sweden and conventional generation and RES in northern Finland and to compensate dismantling of obsolescent existing 220 kV lines.
F6	**Keminmaa-Pyhänselkä**	Planned/Under consideration Seeking permission Expected in operation 2024	This transmission line is part of the third 400 kV AC connection between Finland and Sweden. Project will deliver 800 MW increased in transmission capacity.

4

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Finland

	Project	Status	Description
F7	**Fennovoima NPP connection**	Planned/Under consideration Seeking permission Expected in operation 2024	This project involves a new double circuit 400 kV OHL line between Valkeus (FI) and Lumimetsä (FI). The new line is required for connecting Fennovoimas new nuclear power plant planned to be built in Pyhäjoki. The power plant has a planned generation capacity of 1 200 MW. The decision to build the connection and schedule depends on when the construction permit is given to build the Hanhikivi NPP.
	Olkiluoto 4 connection	Taken out of grid development plan	TVO did not apply for Olkiluoto 4 construction permit. The principle license to build a nuclear plant is expired.

4

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Norway

The grid development in Norway is characterised by several projects in the north-south-direction which will facilitate new renewables, facilitate increased interaction with other countries, prepare increased consumption and at the same time secure an adequate SoS-level.

	Project	Status	Description
N1	**Voltage upgrades through north and mid of Norway**	Several projects Under construction In operation	Will potentially increase the capacity in the north-south-direction. Detailed information given in Statnett's Grid Development Plan 2017.
N2	**Ørskog–Sogndal**	Taken into operation 2016	New 420 kV-line (ca.300 km) will increase capacity north-south-direction and towards mid Norway. The project will increase the security of supply in mid Norway as well as facilitate RES.
N3	**Fosen**	Under construction Expected in operation 2019	New 420 kV-lines in mid Norway (Fosen) in order to facilitate new wind production. Detailed information given in Statnett's Grid Development Plan 2017
N4	**Ofoten–Balsfjord–Skillemoen-Skaidi**	Under construction First part (Ofoten–Balsfjord) taken into operation in 2016/17 Second part (Balsfjord–Skillemoen) expected to be commissioned in 2021 (Skillemoen-Skaidi not final decided)	New 420 kV-line (ca.450 km) will increase the capacity in the north of Norway, mainly to serve increased petroleum-related consumption, as well as increase the security of supply. In addition, the project will prepare for some new wind power production. A line further east (Skaidi–Varanger-botn) is under consideration, however no decisions taken.
N5	**Western corridor**	Under construction Final step expected in operation 2021	Voltage upgrades in the Southwestern part of Norway. The project will increase the north-south capacity as well as facilitate high utilization of the planned interconnectors. Detailed information given in Statnett's Grid Development Plan 2017

4

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Sweden

The grid development in Sweden is characterised by several large projects to increase grid capacity as well as studies on requests for connection of renewable power production. Due to the rather low energy prices it is not uncommon for connections of renewable production to be put on hold by the applicant prior to final implementation.

	Project	Status	Description
S1	**SouthWest Link**	Under construction Expected in operation 2017/18	Will increase the internal Nordic capacity in a north-south direction between areas SE3 and SE4. This will make it possible to handle an increased amount of renewable production in the north part of the Nordic area as well as an increase in trade on Nord-Balt and the planned Hansa PowerBridge with less risk for limitations. The project has been delayed several times due to difficulties in the implementation phase.
S2	**Ekhyddan – Nybro - Hemsjö**	Planned/Under consideration Seeking permission Expected in operation 2023	This is currently a PCI-project and has re-applied for continued status. New 400 kV AC single circuit OHL of 70 km between Ekhyddan and Nybro and a new 400 kV AC single circuit OHL of 85 km between Nybro and Hemsjö. The reinforcements are necessary to fully and securely utilize the NordBalt interconnection that is connected in Nybro.
S3	**North-South SE2 – SE3**	Planned/Under consideration Expected in operation 2017 and beyond	New shunt compensation and upgrades of existing series compensation between price areas SE2 and SE3 are planned for installation between 2017 and 2025. The oldest of the 400 kV lines between SE2 and SE3 are expected to be replaced with new lines with a higher transfer capacity. The first replacement is planned for 2027 – 2030. These reinforcements will together significantly increase the north–south capacity in the internal Nordic transmission grid.
S4	**Skogssäter - Stenkullen** **Swedish west coast**	Planned/Under consideration Seeking permission Expected in operation 2021	New 400 kV single circuit overhead line that will increase capacity on the Swedish west coast. This will lead to better trading capacity between Sweden, Denmark and Norway.

4

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Denmark

The grid development in Denmark includes projects for connection of new consumption (data centres), new generation (offshore wind farms) and domestic reinforcements due to connection of new interconnectors. Some of the most important investments are summarized in the table.

	Project	Status	Description
DK1	**Endrup-Idomland** **Revsing-Landelupgaard** **Idomland- Tjele** **Bjæverskov-Hovegaard**	Planned /Under consideration 2019-21	All projects are 400 kV domestic transmission lines. The purpose of the investments is to integrate on-going and planned connections of renewable generation (off-shore wind farms) and to connect new interconnectors (COBRA, Viking Link, DK West-Germany etc., see section 4.3.3) to the domestic grid.

4

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4.3.2

Cross border projects within the Nordic areas

	Project	Status	Description
CB1	**3rd AC** Sweden - Finland	Planned/Under consideration Seeking permission Expected in operation 2025	The project has applied for PCI-status. New 400 kV AC-line cross the northern border between Sweden and Finland. The line will increase trading capacity and the possibility to exchange system services as well as increase the power adequacy in Finland.

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4.3.3
Interconnectors to continental Europe/Great Britain

	Project	Status	Description
CB2	**NordBalt** 700 MW Sweden – Lithuania	Taken into operation 2016	HVDC subsea interconnection between Sweden and Lithuania that has increased the trading capacity between the Baltic States and the Nordic electricity markets.
CB3	**Kriegers Flak CGS** 400 MW Denmark East - Germany	Under construction Expected in operation 2018	Secure connections to shore are vital for the Kriegers Flak offshore wind farm. Together with German TSO 50Hertz Transmission GmbH an offshore interconnector is being developed. The new interconnector will take advantage of the proximity of Danish and German wind farms by adding short cables and thus connecting the wind farms to both Germany and Denmark. The European Commission is supporting the interconnection with up to 150 m€.
CB4	**COBRA** 700 MW Denmark West - Netherlands	Under construction Expected in operation 2019	The project from Endrup in Denmark West to Eemshaven in Holland is under construction with the installation of cabling and construction of converter stations in 2017 and 2018 with the aim of going into operation in Q1 2019.
CB5	**NordLink** 1400 MW Norway – Germany	Under construction Expected in operation 2020	HVDC subsea interconnector between southern Norway (Tonstad) and northern Germany (Wilster). The interconnector will improve security of supply both in Norway in dry years and in Germany/Continental Europe in periods with negative power balance (low wind, high demand etc.). In addition, the interconnector will be positive both for the European market integration, for facilitating renewable energy and also for preparing for a power system with lower CO_2-emission.
CB6	**NSN Link** 1400 MW Norway – Great Britain	Under construction Expected in operation 2021	720 km long HVDC subsea interconnector between western Norway (Kvilldal) and eastern England (Blyth). The interconnector will improve security of supply both in Norway in dry years and in Great Britain in periods with negative power balance (low wind, high demand etc.). In addition, the interconnector will be positive both for the European market integration, for facilitating renewable energy and also for preparing for a power system with lower CO_2-emission.

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4.3.3

Interconnectors to continental Europe/Great Britain

	Project	Status	Description
CB7	**Denmark West - Germany**	Under construction and Planned/Under consideration (Consenting) Expected in operation 2020 and 2022	On the Denmark West and Germany border there are two projects. The east coast project which is an upgrade of the 220kV lines from Kassø to Jardelund to 400kV, increasing the capacity on the border to 2500MW in 2020. For this project Energinet has obtained the planning permission and the project is now in the construction phase. The west coast project is a project of a double 400kV line from Endrup to Nibüll where it is to connect with the 2 400kV lines being build up along the German western coastline in Schleswig Holstein. This project increases the possibility of exporting and importing electricity on the border from 2500MW to 3500MW in 2022.
CB8	**Viking Link** 1400 MW Denmark West – Great Britain	Planned/Under consideration Consenting Expected in operation 2022	The Viking Link project is under development with the Danish §4 application sent to the ministry in December 2015. The project aims at integrating the electricity markets of GB and DK to increase the value of wind power as well as improving security of supply in GB in the long-term. The project is closely connected to an expansion of the internal western Danish grid as well as additional interconnection to Germany, in the so called West Coast project.
CB9	**Hansa PowerBridge** 700 MW Sweden - Germany	Planned/Under consideration Seeking permission Expected in operation 2025/26	A HVDC subsea interconnector between Hurva in southern Sweden and Güstrow in northern Germany. A decision to start further project work on permissions was taken in early 2017.
CB10	**NorthConnect** 1400 MW Norway-Scotland	Under consideration	A 650 km long subsea interconnector between western Norway (Sima) and eastern Scotland (Peterhead). According to Statnett's Grid Development Plan 2017, a second Norway-UK-interconnector might show positive cost/benefits.

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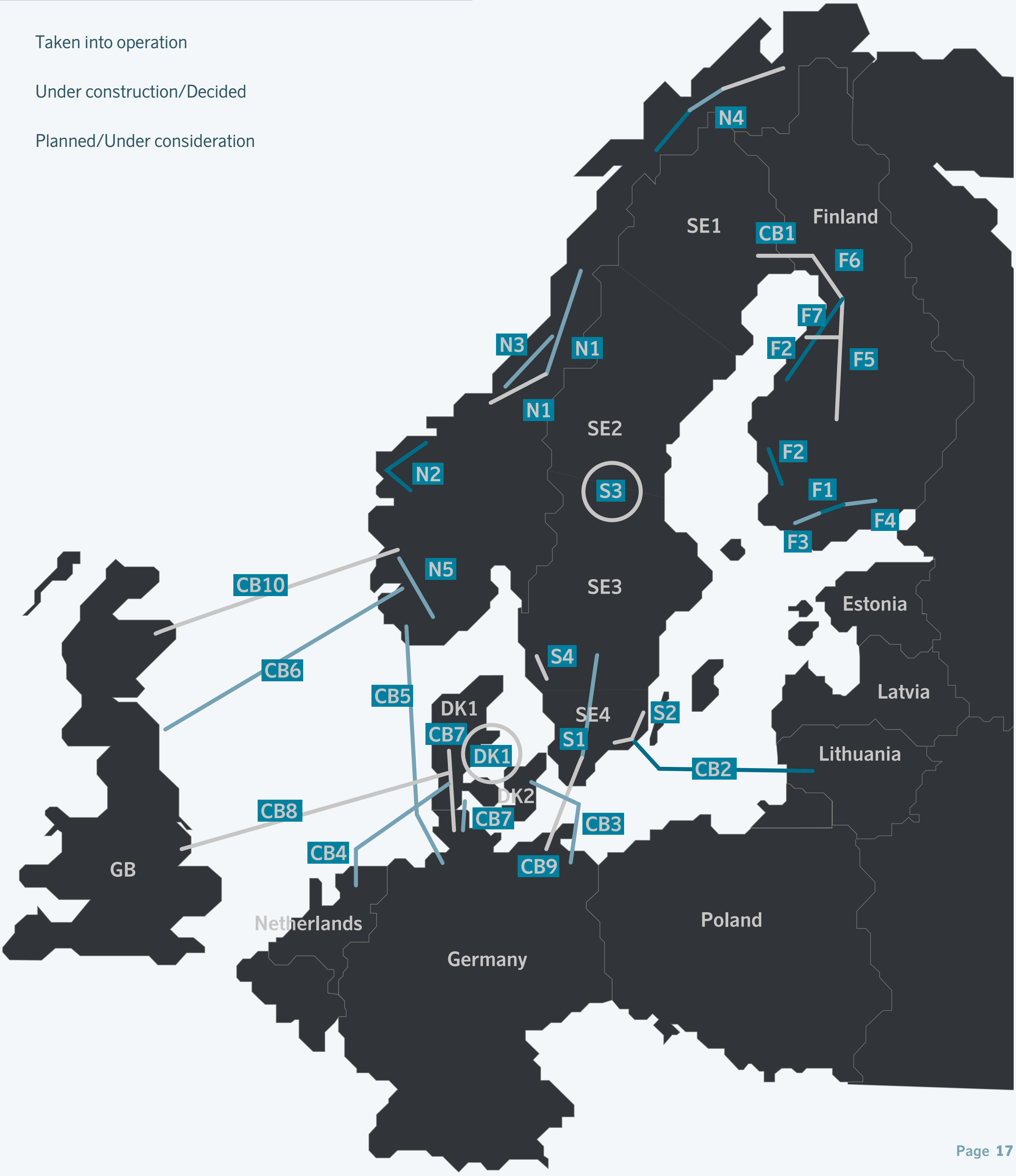
Map of projects

4.4 Map of projects

- Taken into operation
- Under construction/Decided
- Planned/Under consideration



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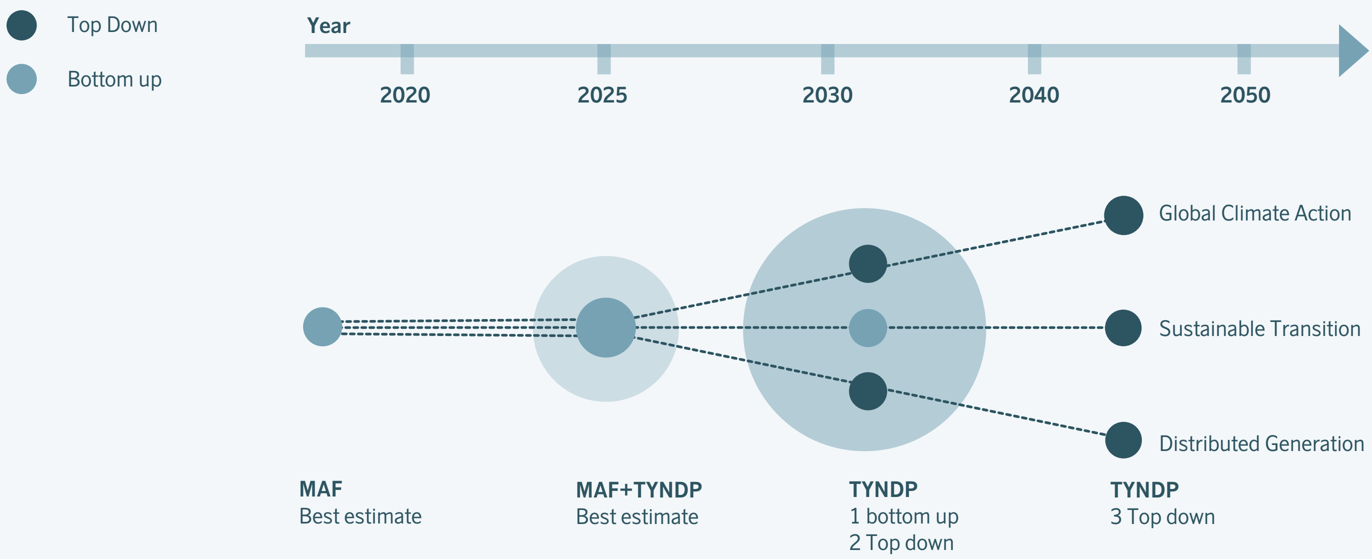
Scenarios for the future

There are several ways to identify a need for increased capacity between two market areas. One is obviously to take note of the price differences seen in the market and if the difference is too large on an average, there is probably a need for reinforcement. However, the future energy system will change, but it is not clear how, and some changes might have a big influence on the market, the power flows and the need for future capacity. These are the reasons why grid development is done using scenarios to predict the future. Since many parameters that affect the electricity market are unknown, several scenarios and sensitivities are used to evaluate how robust an investment is.

5.1 European scenarios for TYNDP 2018

In the work with ENTSO-E´s regional investment plan 2017 and the TYNDP 2018, scenarios for 2025, 2030 and 2040 have been created. There is one scenario for 2025 based on all TSOs best estimate (a so-called bottom-up scenario). From 2025, three different development routes are assumed to create different scenarios for 2030. One scenario is based on the TSO's best-estimate (bottom-up) while two scenarios are created using levels of renewable production and other parameters defined in a top-down approach by ENTSO-E centrally to fulfil different European political goals. For 2040, three more scenarios are created, all of them top down decided scenarios fulfilling all political targets.

Scenario framework



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Scenarios for the future

Scenario year	Scenario name	Description
2025	Sustainable transition "Best estimate"	Development based on currently known plans. More reliable than the long-term scenarios, but still not a forecast.
2030 and 2040	Sustainable transition	A moderate expansion of wind and solar, partly supported by direct subsidies. EU on track with 2030 climate targets, but not quite reaching the targets for 2050.
2030-2040	Distributed generation	Significant leaps in innovation of small-scale generation and storage is a key driver. High expansion of wind power and very high expansion of solar panels. Many residential prosumers.
2030	European target	Based on a scenario developed for the EU Commission. The scenario is quite similar to Global climate action.
2040	Global climate action	A global emission trading scheme (ETS) is a key driver towards meeting both 2030 and 2050 climate goals. The global ETS prevents carbon leakage between countries, and therefore improving the relative competitiveness of energy intensive industries within Europe.

5

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Scenarios for the future

The Nordic input for the European bottom-up scenarios is coordinated by the Nordic TSOs, and is based on each TSOs Best Guess for 2020, 2025 and 2030. Hence, these scenarios might be seen as a common Nordic prognosis. Towards the Nordic Grid Development Plan 2019 these scenarios/prognosis will be further developed.

5.2 Common Nordic scenarios

The Nordic TSOs have commonly created, together with the TSOs in the Baltic States, best estimate scenarios for both 2025 and 2030. They are based on the following main assumptions and trends.

- The European Emission trading system (ETS) is not considered the main driver of decarbonisation in the electricity production sector. This means that coal should be cheaper than gas for power production, however coal as fuel is assumed to be phased out due to national regulations.
- Increased production from wind, solar and hydro (especially in Norway) is assumed due to higher national subsidies, decreased costs for wind and solar production and higher hydro-inflow.
- Nuclear plants are assumed to be decommissioned according to the communicated official plans (Ringhals 1, 2 and Oskarshamn 1) and or by reaching the expected technical lifetime (Loviisa 1 and 2). Rest of the nuclear capacity is expected to still be economically viable in 2030. In Finland two new reactors is commissioned before 2030 (Olkiluoto 3 and Fennovoima1).
- Demand is assumed to grow slowly due to energy efficiency measures. Both Denmark and Norway expect the largest relative growth as a result of electrification in the transport sector as well as from increased industrial demand.
- The slow growth in demand and continued increase in renewable generation will yield a substantial Nordic energy surplus even after some nuclear de-commissioning.

These best estimate scenarios have been used in calculations done in the ENTSO-E Regional investment plans that will be presented in 2017. In order to check for robustness in the results a number of sensitivities, adjustments of single parameters or assumptions, have been applied. The most important ones are:

- Reduced nuclear: Nuclear plants could be decommissioned earlier than expected due to several reasons. The effects of this need to be analysed.
- Low-price: Low prices in combination with continued subsidies could cause low profitability for conventional generation which would therefore be de-commissioned faster. This would lead to an even more volatile system with less schedulable generation capacity.

The Nordic TSOs will continue to jointly develop scenarios to be used in the evaluation of possible reinforcement needs in future Nordic Grid Development Plans.

6

Identified corridors of further interest

In the last ten years a number of new interconnector projects have been commissioned or are under construction between the Nordic countries towards continental Europe and the Baltic States. The status of these projects are described in chapter 4.

The regional drivers described in chapter 3, as well as analysis done by the Nordic TSOs indicate that it is now important to look in more detail on internal Nordic transmission corridors. Sufficient internal capacities are an important factor to utilise the full benefit from the already decided new interconnectors and to assure the function of the Nordic power market. It is also important to make it possible to meet future demands for even more trading capacity between the Nordic countries and surrounding areas in order to accommodate higher levels of renewable power. Such studies will be reported within the scope of the Nordic Grid Development Plan 2019 as well as in the Regional investment plan 2019 and the TYNDP 2020.

The transmission corridors of special interest are characterised by being borders that are expected to see a potentially large increase in power flows. These flows could either be from large amounts of Nordic renewable production being exported through new and existing interconnectors or imported and transported to larger consumption areas when there is low local production of renewable electricity.

6

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Identified corridors of further interest

Norway – Denmark

One of the drivers for investigating future investment needs for the Norway-Denmark corridor is the expected technical lifetime of Skagerrak 1 and 2 which were commissioned in 1977, thus a decision on the future of these lines will have to be taken over the next few years. In addition, further integration between the Nordic synchronous and the Continental synchronous system may be needed in order to provide the flexibility needed for the expected generation-shift.

Norway – Sweden

A possible decommissioning of Swedish nuclear power plants would be the main driver for investigating the Norway-Sweden corridor (NO1-SE3). If decommissioning, increased capacity towards the southern part of Sweden might be needed for an adequate security of supply.

Norway – Finland

The drivers for investigating the Norway-Finland corridor are the possible changes in the Arctic region with both Norwegian petroleum-activities which might increase the consumption as well as very good wind potential that would give a large surplus that needs to be transported out of the area.

Finland – Sweden

The main driver for further investigation of future investment needs is the ageing of Fenno-Skan 1 HVDC link between SE3 and FI and its importance for the trade between Sweden and Finland. The link could be replaced at the current location or moved to a new location between SE2 and FI.

Denmark – Sweden

The corridor between Denmark and Sweden is of interest to investigate since it links areas with hydro power (Sweden and Norway) with areas with high dependencies on wind and solar power. The oldest HVDC link from Denmark west to Sweden, Konti-Skan 2 from 1988, is approaching its technical lifetime and may have to be replaced within the next 15-20 years.

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