

**Statnett**

# Grid Development Plan 2021

Summary



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The green transition is happening now. Statnett will facilitate security of supply, electrification and new green value creation. We will ensure adequate grid capacity for new production, increased consumption and new business activities, thereby becoming an enabler in the green transition. The pace of the transition has accelerated sharply since the most recent Grid Development Plan was published in 2019. The European Union's "Fit for 55" package, the UN's sixth climate report from the IPCC and the sharp increases in carbon prices confirm this trend. As well as climate targets being specified, technological developments mean that a lot of green industry is rapidly emerging. Statnett's long-term market analysis assumes that consumption could increase to nearly 220 TWh annually by 2050, compared to 140 TWh today. The clear increase in power consumption will require more power production, and offshore wind developments have a central role to play here.

## **We have six main messages** for this year's Grid Development Plan:

- We plan to meet a growth in consumption that could bring us up to 220 TWh by 2050
- We are increasing the pace of grid developments and we are planning to 420 kV upgrades in regions with high levels of activity and all transport channels by 2040
- We are planning for offshore grid, both as a system manager and as a planner and we will facilitate the first hybrid connection by 2030
- We are establishing regional plans showing regional target grids and are coordinating system and plant initiatives, reinvestments and new capacity in close collaboration with regional grid companies
- We are playing an active planning role to ensure rational grid development and connection
- We are collaborating with industry, nationally and internationally, to fulfil our social mission

The energy system is facing radical changes. The high pace of electrification experienced in the last year and a half will continue. The 2021 Grid Development Plan shows the level of ambition necessary to keep up with developments. At the same time, changes are happening at a rapid pace, so this year's plan will mature over time and the sequence of initiatives may change.

Statnett will ensure reliable operations and efficient power supply by developing the grid, market and operational solutions for the future in a socially rational manner. We will facilitate sustainable value creation by balancing socio-economic, social and environmental considerations. We will also collaborate closely with grid owners, authorities and other parties to ensure that the development of initiatives keeps up with the development of needs.

### **Electrification, value creation and an ageing grid are the driving forces behind grid development**

The green transition involves a strong growth in customers seeking to connect to the grid. The typical growth in consumption was less than 1 % per year during the 2010–2018 period. Since the last Grid Development Plan was published, volumes corresponding to an annual growth of 5–10 % have been requested in some regions. The highest activity levels are seen towards the coast and around bigger cities. Since the 2019 Grid Development Plan, we have managed an increase in volume of nearly 11,000 MW, virtually all of which is consumption. Large growth in consumption is not realistic without increased production and we anticipate that offshore wind will account for a significant proportion of this. Security of supply will face challenges if there is too much consumption growth without growth in production and grid capacity.

The transmission grid consists of nearly 11,500 km of lines, 2,000 km of cable and 200 stations. Since 2010, we have developed and upgraded more than 2,000 km of lines, three international connections and many stations that, together, have improved security of supply, enabled increased consumption and increased value creation in Norwegian hydropower. The developments we have completed provide us with an excellent starting point for further grid developments. We have also acquired a number of facilities as a result of changes to the Norwegian Energy Act concerning the scope and ownership of the transmission grid.

Nevertheless, increased load and ageing facilities still contribute to an elevated risk of interruptions to the power supply in several regions. We are therefore planning to carry out extensive maintenance and modernisation measures to maintain the functionality of the facilities and ensure high levels of availability. To date, the need for modernisation has been largest for stations and cables, which have a shorter technical service life than overhead lines. We also anticipate an increased need to renew overhead lines in the 2030s. Needs for modernisation will also provide opportunities for predictable upgrades to the transmission grid in regions where the consumption plans are uncertain.

### **Overall planning and close collaboration are crucial to meet the climate targets**

Statnett balances a number of considerations to ensure a well functioning power system and a resilient grid. Grid development requires thorough planning and the lead times are currently long. In order to ensure the pace of the transition, it is therefore essential that we manage to exploit the system in a proper manner through system and market initiatives. We are planning for a transmission grid of 420 kV, which will border a regional grid of 132 kV. A cost-effective and rational development of the power system requires us to view the system and plant developments in the context of different grid levels.

Going forward, we will consolidate and coordinate the needs for increased capacity, modernisation and maintenance, as well as market and operational initiatives through common regional plans. The plans will be drawn up in consultation with regional grid companies and other affected parties. We will also be a clear policy advisor by guiding our customers towards strong points in the grid and by communicating the opportunities accommodated in our plans. The regional plans will describe how the grid in a region will look in future and which system and market initiatives can improve operations and free capacity in the grid. The plans will show progress towards a robust goal that ensures that the grid can manage the anticipated growth.

The increased pace requires regulatory processes to better accommodate the green transition and adjacent grid owners to also make the necessary grid investments. The government has established a committee that will assess initiatives that will affect the grid companies' framework conditions and room for manoeuvre. Statnett will be clear about the initiatives that are required to keep pace with the green transition and how Statnett will improve its own processes to ensure efficient development.

### **We are investing to keep pace with the green transition**

We anticipate that we will invest NOK 60–100 billion by 2030, including investments in offshore grids. There is increased uncertainty after 2030, but we estimate that the average annual investment level will continue in the same range. The increase from the 2019 Grid Development Plan is the result of the increased pace of consumption trends and costs linked to offshore grids. In addition to the NOK 60–100 billion, we anticipate annual investments of NOK 1.5–2 billion for grid acquisition, smaller reinvestments and IT projects.

The lower investment level has been set based on investments related to a predictable need for modernisation. The upper level depends on how quickly consumption increases and where new consumption and new production are located. Offshore wind development on a large scale could also lead to more extensive investments on land than we have taken into account. A challenging supplier situation and increased material costs could also put pressure on price levels and further increase the upper range of the actual outcome.

Our ambition is for all major cities and regions with high levels of activity to have a fully developed 420 kV grid by 2040. Additionally, all major transport channels that link the elspot regions will also be 420 kV by the same time. We plan to complete this work in Greater Oslo, Southern Rogaland, Bergen and the surrounding region, as well as Haugalandet around 2035. We will also conduct a large number of major and minor station modernisation initiatives during the same period.

The transmission grid's share of grid rent for general consumers is expected to rise from the current level of 6.1 øre/kWh (2020 figures, the rate was reduced in 2021 due to the COVID-19 pandemic) to 6.6 øre/kWh in 2030 (actual). Investment costs and congestion revenues will have the greatest impact on rate levels. The increase for ordinary consumers will be less than the total cost picture, as the bill is divided between multiple customers and because we expect an increase in national and international congestion revenues. The increased costs in the power system must also be viewed in the context of the fact that electrification will contribute to increased energy efficiency in the society, the elimination of fossil fuel costs and the climate benefits that will be achieved. Total energy costs for consumers are likely to decrease, even though grid costs will increase slightly.

### **Transport channels: Gradual reinforcement of major transport channels**

The transport channels link the elspot regions together and are also important for security of supply at a regional and local level. Increased congestion and price differences contribute to the

profitability of voltage upgrades before these channels reach the end of their technical service lives. In practice, this will also be required to connect more production and consumption in many cases. We are planning a gradual upgrade of the channels, which will take into account disconnection possibilities.

We are already well under way with the planning of the upgrades to the Central Norway transport channel, 420 kV Åfjord-Snilldal, originating from Sogndal towards Aurland and Modalen and also running between Fåberg and Oslo. The voltage upgrade of the 300 kV Modalen/Samnanger-Sauda channel is next on the schedule. The upgrades will reduce price differences throughout Southern Norway, strengthen security of supply in Western Norway and facilitate increased consumption, particularly in the Bergen region. The next initiative for transport channels will be to increase the capacity between the current price regions NO2 (Southern Norway) and NO1 (Eastern Norway). Nevertheless, it will be important to view the initiatives to increase capacity between these regions in the context of the increasing transmission needs internally within NO2. In particular, we see that more industry in eastern parts of NO2 and offshore wind in Southern North Sea II is resulting in increased congestion to the Grenland region from the south. In order to achieve the effect of increased capacity towards Central Eastern Norway, the capacity in the grid to the south and west of Grenland must also be increased. Other transport channel initiatives are scheduled later and it could become necessary to carry out upgrades gradually.

### **Northern Norway: There could be a need for extensive grid investments in the event of major growth in consumption**

To the north of Tunnsjødal, security of supply and connections for consumption are driving forces behind the grid developments. There were previously plans to establish wind power in Northern Norway and several of these plans have now been realised. In recent years, we have experienced increased demand to establish new industry and to electrify the oil and gas sector, as well as the transport sector. The largest consumption plans are focused in Finnmark and Mo i Rana. We anticipate that it will be necessary to conduct extensive initiatives in these regions, where modernisation needs will be fundamental to developments. We will continue to further develop 132 kV in several regions in addition to the new 420 kV initiatives. Upgrades to the transport channel between Trøndelag and Nordland are scheduled for closer to 2040.

Since 2010, we have established 420 kV all the way up to the old county of Finnmark. We have also carried out voltage upgrades to the 300 kV line between Nedre Røssåga and Namsos and implemented numerous station initiatives. Overall, these initiatives have increased the capacity for connecting consumption and production and increased security of supply in all of Northern Norway.

We are in the process of further developing the 420 kV grid in Finnmark. New 420 kV lines from Skaidi to Hammerfest, as well as to Adamselv and Varangerbotn, will increase capacity internally in Finnmark and facilitate some increased consumption and production. We are also planning several station modernisation initiatives to safeguard local security of supply. Nevertheless, capacity in the region is limited due to the capacity to Finnmark and there is a need to increase capacity to the region in order to keep up with consumption. Previous investigations have shown that an additional connection northwards from Balsfjord could be relevant. Improved utilisation of capacity to Finland is also a priority.

In collaboration with regional grid companies in Lofoten/Vesterålen, Statnett has drawn up a gradual strategy for the further development of the 132 kV grid. We are planning a new line to further increase capacity in the region as the next step after 132 kV Kvandal-Kanstadbotn. We are also planning a number of cable and station modernisation initiatives. In Helgeland we are

planning a new station in Rana. As well as solving the flicker issues, a new station will increase capacity and strengthen security of supply in the region. A new 420 kV line will be required if there is significant new consumption.

The collective consumption plans may give rise to a need for extensive initiatives in the north. The scope of initiatives increases the further north such consumption is located. In addition to the aforementioned initiatives to the north of Balsfjord, further reinforcement may also be required between Nedre Røssåga and Ofoten if high consumption levels are realised.

### **Central Norway: Further development of the 420 kV grid in the entire region to fulfil consumption plans**

The Central Norway region consists of the counties of Trøndelag and Møre og Romsdal. We have carried out voltage upgrades to large parts of the 300 kV network to and through the region since 2010, as well as building new lines towards the coast of Trøndelag and towards Sweden. The investments have improved security of supply and facilitated wind power developments in the region. A number of plans have been introduced in recent years to establish new industry and electrification, something that rapidly increases consumption. There has also been growth in ordinary consumption and modernisation needs, particularly around the city of Trondheim. We are planning a number of initiatives to increase capacity and renew the grid. We will replace 300 kV with new 420 kV lines and new lines will also be installed in regions with little available capacity. The transport channel through the region will be in operation in 2027.

Statnett is progressing well with the planning of initiatives to increase capacity in the region. We have initiated development projects to link the 420 kV stations in Åfjord and Snilddal. In connection with this, we are planning to increase the capacity by upgrading to 420 kV in the existing connection between Surna and Viklandet. The initiatives will facilitate increased consumption and production along the Trøndelag coast. We have also conducted an investigation relating to Greater Trondheim in collaboration with Tensio. The target grid for the Trondheim region is 420 kV throughout and the initial initiatives are the modernisation of and increased capacity in existing and new stations. The initiatives will cover the needs for both capacity and modernisation. It may be possible to simplify the remaining 300 kV grid when all of the planned investments have been realised.

There is no available capacity in the grid to connect additional consumption in Nordmøre and Romsdal. Accordingly, Statnett has, in collaboration with Istad and NEAS, considered several concepts for future supply to the region. Statnett is planning to proceed with 420 kV initiatives towards the coast. Until the increased line capacity is in service, we will increase local transformation capacity in several stations and will use market and system instruments to connect some additional consumption.

### **Western Norway: High priority initiatives along the coast of Western Norway**

The Western Norway region consists of the counties of Vestland and Rogaland to the north of Boknafjorden. The grid capacity in the region has been strengthened through several new lines into and internally within the Bergen region since 2010. The pace of electrification has been rapid and much quicker than we predicted just a few years ago. The Bergen region could experience a doubling of the current consumption level, with most attributable to the electrification of the oil and gas sector and the establishment of new industry along the coast. Industrial establishments are also planned for the Haugalandet region and there may be some offshore wind from the coast. In the short and medium term, we are planning a number of major grid investments, as well as system operations initiatives to fulfil the consumption plans along the coast. Both the

modernisation of the 300 kV grid and new developments will be necessary to cover developments in consumption. We will start the upgrades to the transport channel from the north and will continue from the south.

In the Bergen region, we are therefore planning extensive 420 kV initiatives in line with the concept selection study conducted for the region, as well as the system operations initiatives. The initial investments are modernisations and increased capacity at several stations, as well as increased capacity for cables in the outer parts of the region. The next investments are voltage upgrades/increases from Sogndal via Modalen to Kollsnes, as well as the transport channel southbound towards Sauda. The next step will involve a new connection to Kollsnes, before we carry out voltage upgrades to bring the remaining 300 kV grid up to 420 kV in the region. We are now awaiting the Norwegian Ministry of Petroleum and Energy's consideration of the concept selection study for the Bergen region.

Statnett has applied for a licence for a new 420 kV power line from Blåfalli to a new Gismarvik station in Haugalandet. The line will allow for the opportunity to connect more consumption in Haugalandet. Gismarvik will also become an important station for the connection of offshore wind power production from Utsira North. The next step in Haugalandet will be a new 420 kV line towards the coast and modernisation needs mean that we anticipate this to become the replacement for one of the 300 kV lines from Sauda.

Sogn og Fjordane differs from other regions. Here, several plans have been drawn up for the establishment of new power production and a growing power surplus is expected. We are planning to upgrade several stations to fulfil the production plans. In Odda, we have restarted the station project to realise the connection of new consumption in dialogue with the parties that triggered the initiative.

### **Southern Norway: The sum of consumption and production influences the grid across all of Southern and Eastern Norway**

The Southern planning region covers the part of Rogaland that lies to the south of Boknafjorden, as well as Agder and Vestfold and Telemark. We have increased our international exchange capacity since 2010 through multiple international connections. We have also built new 420 kV corridors through the region. These corridors are strengthening the security of supply and facilitating new power production and efficient utilisation of the international connections. Major consumption plans have been added along the coast and around Grenland in recent years. Several of the plans have been added in the last year alone. Offshore wind power from Southern North Sea II will also be connected to the region. The sum of offshore wind power production and new consumption will influence flow, congestion and power system developments across all of Southern and Eastern Norway. We expect the region to also be characterised by high levels of new developments in the future, including upgrades both of the old 300 kV grid and new 420 kV lines.

Statnett is in the process of strengthening security of supply to Southern Rogaland, with a new 420 kV line from Lyse to Fagrafjell. Security of supply in northern Jæren is unsatisfactory and we have therefore submitted an application to install a new 420 kV line from the new Fagrafjell station to Bærheim station. Nevertheless, the aforementioned initiatives do not provide sufficient capacity to fulfil known consumption plans. We are therefore planning to conduct voltage upgrades to the 300 kV lines from the south to Fagrafjell in order to increase capacity to the region.

The major plans to establish new industry in Agder will initially result in a need for local initiatives with increased transformation capacity at several stations and a new station in Kristiansand. The sum of the plans over time may trigger the need for greater line reinforcements internally in the county.

Large proportions of the old 300 kV Statnett plants can be found in Vestfold and Telemark. There are also plans to establish new industry around Grenland, preferably in the eastern part of the county. Statnett is in the process of planning increased transformation capacity and new stations to manage modernisation needs and consumption plans. The next step could involve major line upgrades towards the Oslo region. Such upgrades must be viewed in the context of the congestion between NO1 and NO2 and the connection of offshore wind power from Southern North Sea II. Statnett plans to conduct a major "Southern Norway study" in the coming period.

### **Eastern Norway: Grid upgrades around Greater Oslo continue**

The Eastern planning region covers Innlandet, Viken and Oslo. Statnett has long been working on upgrades to the grid in Greater Oslo and we currently have several projects in the pipeline in connection with upgrades and capacity increases. Some wind power has previously been established in Innlandet, while there has been some growth in consumption around Oslo. Several plans for industrial establishments in Viken and Innlandet have been submitted in recent years. We also anticipate further growth in ordinary consumption, particularly in Greater Oslo. Grid development is also influenced by the flow through the region towards Sweden. The 300 kV grid is also among the oldest assets owned by Statnett and the condition of the system indicates that modernisations must be highly prioritised. Going forward, initiatives will largely involve the development of new 420 kV lines to replace the current 300 kV.

Further grid upgrades are also planned for the Greater Oslo region. We were recently granted a licence for a new 420 kV line between Hamang, Bærum and Smestad and we are planning to submit a notification for a new 420 kV line between Fåberg and Oslo. In Hallingdal, we are initially planning the modernisation of stations and the assessment of the station structure in connection with this.

The timing of the upgrades to the remaining 300 kV grid in the area will depend on modernisation needs and developments in consumption. We anticipate that the upgrades to the 300 kV lines around Flesaker and to the east will be completed first. In southern Viken (formerly Østfold), the sum of the consumption plans may accelerate modernisation and voltage upgrades.

### **International connections and offshore grid: We plan for offshore wind power by 2030**

In the last year, Statnett has commissioned two international connections totalling 2,800 MW to Germany and England. It is crucial that Statnett gains experience of how this influences system operations before assessing whether to further increase capacity. At the same time, increased transmission capacity between countries is essential for Europe to meet its climate targets and Statnett's cables provide a solid socio-economic benefit for Norway. The future need for new connections is analysed through the Nordic Grid Development Perspective 2021 and ENTSO-Es European Plan 2022 (TYNDP 2022) reports.

Falling development costs and increasing carbon and power prices mean that offshore wind power in Southern North Sea II will likely be profitable even before 2030. Statnett analyses show that a hybrid grid solution that connects offshore wind power to Norway and another country is significantly more socio-economically profitable than radial connections, partly due to the relatively short distance to other countries. There is also broad agreement between the participants in the industry that hybrid connections will be necessary for offshore wind power developments to be profitable. We are planning to complete one hybrid connection (HVDC) by 2030.





The development of hybrid connections is associated with long lead times and the development of the solution must commence before deciding which parties will be granted a license to develop offshore wind power. In order to ensure the rational development of the offshore grid, the operation and development of the grid on land and offshore must be viewed in context, including the location of new production and consumption. Offshore connections will influence flow and congestion in the grid on land and there may be a need for national investments as described above. The further development of offshore wind power after 2030 is likely and could further increase the need for domestic grid reinforcements.

Several of the existing international connections will be reaching the end of their technical service lives over the next twenty years. A development must be considered by both countries before any investment decisions are made. We are currently in the process of a feasibility study to assess if and when it may be relevant to reinvest in the oldest cable connections between Norway and Denmark. Any reinvestment must be viewed in the context of the development of offshore wind power, offshore grid and consumption trends on land. We are also experiencing increased flow and congestion between Norway and Sweden, particularly in Northern Norway in connection with significant growth in consumption.

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