

**Statnett**

# Norwegian Grid Development Plan **2017**

Short version





## Summary

The transmission grid is a central part of society's infrastructure. Planning and constructing the grid according to needs and profitability is one of Statnett's most important tasks. Through efficient grid development, the goal is to contribute to increased value creation, facilitate the reduction of greenhouse gas emissions and maintain a safe power supply.

The Regulations relating to energy planning designate Statnett as Norway's planning body. In the 2017 Grid Development Plan (Nettutviklingsplan, NUP 2017) we outline relevant development characteristics, uncertainty factors, and expected grid investments over the next 20 years. NUP is our public, main report and a summary of the Power System Plan (Kraftsystemutredningen). Requirements with regards to the plan's contents are regulated through the Energy Act's Regulations relating to energy planning. Statnett also provides the 2017-21 System Operation and Market Development Plan (Systemdrifts- og markedsutviklingsplan 2017-21, SMUP). Together, NUP and SMUP describe how Statnett aims to fulfil its societal role in the most comprehensive and cost-effective manner possible. This year, we are presenting new editions of NUP and SMUP together for the first time. The aim is to make it easier to understand the overarching nature of the many initiatives, and to facilitate the widespread inclusion of the transmission grid's stakeholders.

Grid capacity will experience a boost in many parts of the country towards the first half of 2020. This will result in improved supply security in vulnerable areas such as northern Norway, the greater Oslo area and the Stavanger region. We have the capacity to process a significant amount of new consumption and production, and will also have two international interconnectors to Germany and England in operation. With this in place, we are now entering a new phase where the overall level of investment is most likely to decline. During this phase we will be increasingly focused on utilizing the grid, upgrading old grid facilities, and the need to keep costs and tariffs down. At the same time, Statnett will have to fulfil a societal need that has the potential to develop in a different manner than we are currently experiencing. We are therefore actively working to be a step ahead through plans that take this uncertainty into account.

### High levels of development throughout the next few years – more uncertain development thereafter

We are now in a period of unprecedented amounts of development activity. In 2016, Statnett's grid investments amounted to NOK 5.4 billion and throughout the next five years we expect to invest NOK 40-50 billion. Uncertainty increases thereafter, in relation to the need and profitability of planned projects, as well as the potential emergence of new projects.

We presently know that many facilities must be upgraded in order to improve and maintain supply security towards 2035-40. How high investment levels will be apart from this depends on a number of factors:

- Development of electricity prices
- Amount and location of new renewables
- How consumption develops, including if and where new industrial consumption occurs
- Increased price differences between countries, making international interconnectors more profitable
- Technological evolution and digitalization of grid facilities and at the end user

Development of subsidy free wind and some hydropower could become profitable in Norway within a few years. Should this happen, many more renewable projects could be realized, even if the certificate system is terminated. This could in turn trigger new grid initiatives, especially in areas with low grid capacity.

Statnett is constantly working towards being a step ahead with plans that account for uncertainty. This includes, among other things, identifying needs, possible initiatives, and profitability, all during early stages, through analysis and dialogue with producers, consumers and regional grid companies. As a rule, we abstain from making final investment decisions until both needs and profitability are relatively certain. We halt or postpone projects in cases where these variables do not develop as expected.



### Strategy for limiting the growth of costs and consumer tariffs

Selecting and developing cost effective measures is an integral part of Statnett's societal role. This is especially pertinent in the phase we currently find ourselves in, where large development projects are driving up cumulative costs as well as the transmission grid's tariff basis. A central goal of Statnett's new company strategy is limiting cost growth and halting common supply tariff increases within 2023. With this ambitious goal, we are strengthening our focus on cost efficiency, and are working on several concurrent measures:

- Reducing unit costs for new facilities
- Using existing and planned grid capacity more efficiently
- Providing better information and price signals with regards the grid and the localization of new, meaningful consumption and new production
- Prolonging the life cycle of facilities by better predicting and targeting the need for replacements and maintenance
- Ensuring that individual parties pay for extra delivery quality
- Contributing to reduced consumption peaks when this can reduce grid investments

For several years, Statnett has worked systematically towards more cost-effective development. Our goal is a 15% cost reduction by 2018, as compared to 2013. In order to achieve this, we have a comprehensive research and development program with a goal of achieving a 20% reduction in costs, increased safety, and reduced completion times. We actively adjust our projects in order to implement new technologies. In addition, we employ standardised solutions and are working towards accessing a supplier market of high quality and capacity. Altogether, this results in lower unit costs, and we are now seeing good results. Compared to contracts from 2011-2013, unit costs have been reduced by an average of 9% for the 2014-2017 period. Development has been increasing and in 2016 the price level was 11,6% lower than in 2011-2013. Combined with tight project management, we are now experiencing a positive development on the project level, where the cost frameworks for the Ofoten-Balsfjord, inner Oslofjord cable installation and Namsos-Surna line alone have been reduced by NOK 1,4 billion.

Improved usage of the existing grid capacity reduces our development costs, and is something we have been working on for many years. Technological and market development can render investments superfluous, making it possible to hold off on investments. We will weigh the risk of supply interruptions against investment costs to a greater degree upon future grid investments. The use of sensors and new technology reduces the consequences of such an approach on operations.

Placement of new production and new, large consumption units in locations with good grid capacity can result in large savings. It is therefore important to ensure that various location signals for

new production altogether provide a correct consideration of the advantages of, for example, good wind conditions, and potential significant grid costs as well as relatively high transmission losses. The tariff model is important here, and in 2018 Statnett will present modifications in the formulation of tariffs. The goal is effective usage and development of the grid. The following premises form the basis of this work:

- Price signals throughout the market and tariffs must together ensure an effective usage and development of the grid. Market signals alone will not provide adequate price signals. There is therefore a need for additional tariff price signals. Construction contributions will be a significant contribution in ensuring socio-economic development.
- All users must account for the costs they incur the system in the short term (marginal loss) and carry the costs they incur the balancing of the system.
- Producers and large as well as small consumers incur a socio-economic loss by paying for fixed grid costs. It is hard to justify that only some users should contribute to paying for the increased costs. This means that both producers and large consumers should pay a, relatively speaking, larger portion of the costs going forward.
- Private cables will benefit from transmission grid investments. The economic framework for private cables is not yet in place. Clear frameworks must be established with a goal of reflecting the direct and indirect costs the cables will incur the transmission grid.

We are planning and developing measures that will reduce short term consumption peaks in cases where this triggers future investments in increased grid capacity. Additional analyses indicate a significant potential for the equalization of consumption without a significant loss of comfort. Demand tariffs, which the Norwegian Water Resources and Energy Directorate (NVE) plans to implement, as well as voluntary agreements are examples of tools which can ensure that adequate amounts of consumption are reduced or relocated as needed. A more general reduction in winter consumption will also contribute to this, for example through the development of remote heating or subsidies for isolation installation. All in all, this limits the future investment level.

### Northern Norway: Consumption is important in Finnmark – production can lead to development towards Sweden and central Norway

We are currently carrying out significant grid investments in order to strengthen supply security and increase transmission capacity into and out of northern Troms and west Finnmark. The Ofoten-Balsfjord and Balsfjord-Skaidi power lines – initially to Skillemoen, are under construction and should be in use in 2017 and 2021, respectively. There will, however, be limitations – especially in east Finnmark. An increased growth in petroleum-related consumption could trigger the construction of a new 420 kV grid through Finnmark and on to

Finland. Thus, Statnett has prepared several reinforcement alternatives. However, uncertainty surrounding if, when and where a large enough increase in consumption could occur in order to trigger such a development, means that we are not approving further projects at this time. Results from the planned mapping of the Barents Sea in 2018 will be important for further work.

There is a large potential for continued development of wind and hydropower in the whole of northern Norway. Conditions for wind power are especially good in Finnmark. With increased electricity prices this could be one of the first places to experience profitable development of unsubsidized wind power. However, we have concluded that as of today, it would not be profitable to construct a 420kV grid through and out of Finnmark for the purposes of wind power alone. The associated grid costs are too large and the relative advantage of good wind conditions too small. In the meantime, we are planning a power line from Adamselv and Lakselv. This will facilitate increased wind power production in east Finnmark.

Northern Norway is, overall, a surplus area. More wind and hydro power, not only in Finnmark, but throughout northern Norway, therefore results in increased flow to central Norway and Sweden. Our analyses show that only relatively moderate volumes of new production would need to occur before various network constraints take place, lowering area prices in northern Norway. Increased regional consumption, such as the electrification of the LNG terminal on Melkoya, will have a dampening effect, but will not prevent larger price differentials. A large-scale development of wind and hydroelectric power in northern Norway therefore necessitates the strengthening and construction of new power lines to central Norway, Sweden and possibly Finland. An expansion towards central Norway alone would not suffice as much of the electricity would still flow towards Sweden and meet limitations on the lines there.

We have no concrete plans to construct new power lines to Sweden, however we are in the process of upgrading one of two lines to central Norway. Our long-term plan is to also replace the second line so that both carry 420 kV.

### Central Norway: Wind power and development in northern Norway crucial for further development

In December 2016 we put a new 420 kV connection between Sogndal and Ørskog online. This measure provides good energy security in central Norway for the foreseeable future. The deficiency in the regional energy balance is thus no longer a relevant factor for continued development, even in the event of a significant increase in consumption.

Increased industrial consumption can however lead to measures on a more local scale. The gas processing plant in Nyhamna is in the process of expanding its capacity and will thus be more vulnerable to interruptions in the power supply. As per its statement concerning our choice of concept analysis, the Ministry of

Petroleum and Energy supports Statnett moving forward with the planning of measures designed to strengthen delivery dependability. The Energy Act facilitates Statnett and users being able to enter into agreements which increase delivery dependability and the Ministry, in its statement, declared that Statnett should facilitate this.

The decision to develop 1000 MW of wind power at Fosen, in Snillfjord and Hitra entails the construction of two new 420 kV power lines, one on the north side of Trondheimsfjorden and one on the south side. We plan to link these together with a cable over Trondheimsfjorden. Together with reinforcements north towards Nordland and south to Sunndalsøra, this would result in a continuous, second 420 kV power line through Trøndelag and Nordmøre. Such an extension would mainly be driven by the increased development of new production in northern Norway and may therefore occur further in the future. As a result, the license to link the grid over Trondheimsfjorden has been postponed until 2028, at the latest.

### Western Norway: Local consumption increase and potential for high levels of renewable development

Supply security in the transmission grid in the Bergen area will be good once the entirety of Ytre Ring from Mongstad to Modalen is completed. BKK has already put the Mongstad-Kollsnes power line into operation, while Modalen-Mongstad is in the process of being completed, with plans to be operative in 2019.

The new power line between Ørskog and Sogndal enables the connection of much new production along the line. At the same time, more production means a gradual increase in bottlenecks towards the south on the connecting power line between Sogndal and Aurland. We therefore planned to apply for a license in 2017 in order to replace this line with a new 420 kV line. Given low energy prices and uncertainty regarding further development of new production, we have temporarily postponed the decision to submit the license application until early 2018.

The company NorthConnect plans to construct a new 1400 MW connection from Sima to Scotland. This connection would provide increased flow from the north and would most likely require an upgrade of the Aurland-Sogndal line. NorthConnect may also trigger other measures. We will perform an evaluation of all grid reinforcements triggered by NorthConnect during the autumn of 2017.

Our longer-term plans include an upgrade to 420 kV of the entirety of the line between Sogndal and Sauda. We first plan to strengthen sections of the line between Evanger and Samnanger. Beyond this, we have released a preliminary notification concerning an upgrade of the line from Samnanger to Mauranger. However, whether and when this will be economically profitable is uncertain.

Plans regarding an increase in industrial consumption in Haugalandet and in Odda could result in new grid initiatives. In Haugalandet, the first step is to install reactive compensation and to temperature

upgrade lines. We would most likely construct a new power line from the east in the event of continued growth in consumption. We have initiated an evaluation process in Odda in order to consider needs and possible measures, but this process is in its early stages.

#### **Southern and Eastern Norway: Increasing consumption, supply security and transit driving development**

Statnett has withdrawn its license application for Lysebotn-Stølaheia and applied for a license for a new connection between Lysebotn and Fagrafjell in order to improve the supply situation in the Stavanger and Sandnes area. In addition, Statnett and Lyse Elnett are currently researching concepts for continued grid development towards Stavanger, in order to ensure a holistic development of the regional and transmission grid.

New international interconnectors to Germany and Great Britain have resulted in increased transmission capacity in the western corridor. This is one of the causes of voltage upgrades and the construction of new power lines from Sauda in the north to Fedaa and Kristiansand in the south, as well as the connection from Solhom to Arendal.

In and around Oslo, power consumption is increasing as a result of population growth and the electrification of the transport sector. Several facility upgrades are also necessary. In the grid plan for the greater Oslo area (Nettplan Stor-Oslo) we examine how we can ensure a holistic development of the grid in Oslo and Akershus. Confirmed investments include the upgrade of Smestad station and the installation of a cable between Smestad and Sogn, and several other large projects will likely follow in the next few years. Once the entire plan is completed, the grid will be able to transport roughly 60% more electricity, whilst having fewer connections.

We are in the process of renewing the innermost cables in Oslofjorden. This reduces the probability of errors and increases dependability in the transmission capacity between Norway and Sweden. In addition, we are also increasing the capacity of several transformer stations in the region. This measure secures the supply for common consumption.

Upgrading the lines from Fåberg to Oslo may be necessary, amongst other things as a result of increased amounts of hydro-power in Gudbrandsdalen and new wind power in Hedmark. In the longer term, increased energy prices and the continued reduction of Swedish nuclear power may make capacity development between Østlandet and Sweden of interest.

#### **Construction of two international interconnectors – further development can eventually be profitable – uncertainty abounds**

Statnett is currently constructing two new international interconnectors: NordLink to Germany and NSL to Great Britain. Both connectors will have a capacity of 1400 MW and are planned

to start operations in 2019 and 2021, respectively. This will result in a combined transmission capacity of 5200 MW to Great Britain, Denmark, and the continent. The connectors will provide increased bottleneck income, increased value of Norwegian energy production, cheaper import rates and improved energy security. The phase-in of more renewable energy production in Norway and receiving countries will also be facilitated.

We carried out an updated evaluation of the economic profitability of NordLink and NSL in the autumn of 2016 as a result of downgraded energy pricing expectations and delays in the construction of the German grid. The new calculations indicate that both NordLink and NSL have retained their profitability. Nordlink's profitability is lower but nevertheless positive with good margins. The largest incomes are to be found further ahead in time. For NSL, updated profitability is roughly the same as determined at the time of investment approval, however here also the most meaningful income is expected in the long term. Reduced bottleneck income for both connectors during the first few years will result in a larger increase in consumer tariffs than projected at investment approval. At the same time, we expect the connectors, taking the updated analysis into account, to result in a somewhat lower price increase on the Norwegian and Nordic side. The net effect for consumers, as per today's network tariff structure, is thus more moderate than the isolated tariff effect.

We are presently focusing above all on increasing value creation from the growing portfolio of connectors. We are doing this by completing ongoing investments in an effective manner, ensuring strong connector accessibility, and by having secure operations and maximizing commercial income. We are also examining the potential for additional economically profitable international interconnectors.

With an increased transmission capacity, energy prices in Norway will be more akin prices at our commercial partners. Seen in isolation, this results in lower economic profitability related to the construction of additional connectors. At the same time, our calculations show that more renewable production, in Norway and elsewhere in Europe, will likely contribute to increased price differences in the long term, thus increasing the benefits of a larger transmission capacity. This indicates that one or several new connectors to Great Britain or the continent could become economically profitable throughout the 2020s. A cable to Great Britain could become profitable earlier as a result of conditions specific to the British market, with more gas in the production mix and a local CO2 tax. Our calculations show that bottleneck income constitutes a small portion of the totality of benefits related to a new connector, as compared to NordLink and NSL. However, the contribution to Norwegian energy security is less meaningful.

If and when continued construction of international interconnectors will become profitable is uncertain. Firstly, there is great uncertainty surrounding market evolution and the nature of the

development of price differences between Norway, the continent and Great Britain. Secondly, there are a number of uncertain and unresolved conditions which may be very meaningful for the utilization and profitability of more connectors:

- Costs associated with necessary grid reinforcements on Norwegian dry land
- System operation costs
- Grid capacity at potential commercial partners
- Regulatory conditions

We are currently implementing a number of initiatives relating to system operations and market design in order to fully exploit the capacity of the connectors which we are now building to Great Britain and Germany. Shorter time steps in the markets and increased system operations automation are examples of necessary initiatives. These initiatives are described at length in Statnett's System Operation and Market Development Plan (SMUP 2017). However, just how sufficient these initiatives are, together, is a source of uncertainty. Should experience show that they are not sufficient, or that they fail to be executed as planned, then other means would need to be developed. This could reduce the utilization of existing and new connectors, resulting in lower usefulness.

The large amount of uncertainty surrounding the economic profitability of additional international interconnectors means that we are not currently initiating new development projects at this time. This could however be of interest throughout the 2020s. Statnett also plans to perform a purposeful analysis in order to reveal the extent of additional grid reinforcements which would prove necessary should more international interconnectors be constructed.

#### **Strong renewables capacity, given favourable conditions**

We have conducted extensive assessments concerning the extent of the renewable energy production capacity of the transmission grid, taking into account ongoing and planned grid reinforcements. The results are uncertain and temporary. We will continue to work with this towards the summer and will provide a more comprehensive description in the final version of NUP 2017 in October.

Our temporary analyses indicate that it is possible to significantly increase production whilst avoiding significantly greater price differences between elspot areas compared to those present at this time. Altogether, we estimate that Norway has the capacity to implement roughly 15 TWh of new production beyond that which is already approved or under construction. This requires favourable geographic placement, with large amounts of projects situated in southern Norway.

Optimal utilisation of the grid requires clear signals concerning where new production should be established. However, we draw attention to the fact that cases can occur where reinforcing the grid in order to exploit good wind conditions would be more profitable for society rather than limiting construction of wind power facilities

to locations where grid capacity is already high.

#### **HSE is our first priority**

Theoretically, an increase in the amount of construction projects entails a greater risk of personal injuries. Statnett thus devotes a great amount of time and resources to reducing this risk to an absolute minimum, and has a vision of zero accidents. This entails clear and safe work procedures, systematic analyses to reveal dangerous situations before they occur, extensive reporting of incidents and the close follow-up of all our construction project contractors. In 2016, we initiated an HSE action plan including concrete improvement measures in several areas of our operations, affecting all who work in and for Statnett.

Our environmental policy is defined by the equal weighing of environmental, technical and economic considerations in all of our decisions. We must gain a solid knowledge base in order to find the best solutions. We achieve this through the early identification of potentially affected vulnerable natural areas and wildlife. We continuously and systematically work to reduce environmental effects through concept choices and planning processes. We prepare an environment, transport and construction plan prior to construction start, outlining how nature and the environment are to be considered throughout the construction and operation of facilities. We have also initiated a project to chart greenhouse gas emissions from our facilities, and, based on the results, will initiate various measures in order to reduce emissions.

#### **Cooperation regionally and in the Nordic region is important**

As a whole, coordination between the development of the transmission grid and the various regional grids will in many cases lead to improved and more cost-effective solutions for society. Statnett is thus concerned with cooperating efficiently with regional grid companies.

Statnett is developing Nordic solutions to Nordic challenges together with the Nordic TSOs. We are doing this in order to ensure that the Nordic power system is prepared to meet the meaningful changes we predict will occur following a significant increase in the proportion of unregulated renewable energy, as well as the phase out of nuclear power and remaining thermal production. The report "Challenges for the Nordic power system" outlines the most important challenges we now face. The original plan was to present a new report in the summer of 2017 identifying solutions and further efforts, however this report has been postponed due to negotiations surrounding Nordic cooperation with regards to system balancing, which will affect several solutions. A Nordic "Generation adequacy report" will however be published prior to the summer, focussing on initiatives within market design and system operations. Efforts towards Entso-E are being coordinated at the Nordic level and several positions are being prepared. Beyond this, we plan on strengthening this work with common Nordic grid development plans.

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