Grid development plan 2013

National plan for the next generation main grid

Statnett

Content

Statnett

Statnett is Norway's transmission system operator and as such has the overall responsibility for managing and operating the national electricity system. Statnett is not responsible for the generation of electricity but for ensuring that the electricity reaches the consumers. Statnett owns approximately 90 per cent of Norway's main power grid. This is made up of the highest-voltage power lines and sub stations, which transmit electricity to an entire region, a number of regions or the country as a whole.

Statnett will manage the main grid on the basis of sound socio-economic criteria. This means providing Norwegian consumers with a reliable supply of electricity with sufficient capacity at the lowest possible overall cost. Statnett will facilitate a well-functioning electricity market with a stable and high quality of delivery. The company is responsible for Norway's main power grid and has a statutory duty to ensure that it is open to all participants in the electricity market. In situations with a limited supply of electricity, Statnett will also monitor the situation continuously and consider various measures that can be taken to assure the electricity supply.

Statnett SF is owned by the Norwegian State and organized pursuant to the Act relating to state-owned enterprises. The ministry of Petroleum and Energy represents the State as owner. Statnett's revenues are regulated by means of a revenue cap set by the Norwegian Water Resources and Energy Directorate (NVE). The purpose of setting an upper limit for revenues is to create predictable economic operating conditions for the grid companies, whilst also restricting the possibility for excessive returns from grid operations. Most of Statnett's revenues are earned from leasing transmission facilities to the parties of the Main Grid Commercial Agreement. The intention of this agreement is to cover the costs incurred by the owners of the national grid for developing and maintaining the grid.

Statnetts mission is to:

- Ensure quality of supply in the short term by coordinating electricity supply and demand
- Ensure quality of supply in the long term by developing the Norwegian national grid
- Offer access to the power transmission grid on equal terms to all by administering the Main Grid Commercial Agreement
- Ensure accessible transmission routes by means of good maintenance practices.

Foreword

Statnett's tasks are to ensure a reliable supply of electricity all over Norway, contribute to increased value creation for Norwegian society and lay the foundation for climate-friendly solutions.

The next generation main grid is on the path to become a reality. In 2012, and again in 2013, we completed and upgraded twice as many kilometres of power lines as in previous years. Construction activities will continue to increase toward record levels. Statnett is working both in-house and with our contractors to increase our implementation capacity in a cost-efficient manner – while we also maintain a good HSE performance and stable operations in a period of high construction activity.

Since our last Grid Development Plan was issued in 2011 several matters have highlighted the need for a stronger grid: The Norwegian parliament has endorsed more stringent requirements concerning security of supply, targets have been adopted for increased renewable power production, and the electricity certificate market has been implemented. Several new petroleum discoveries have been made lately. Decisions concerning electrification on land and offshore will affect the future grid development.

We will strengthen the grid infrastructure in Norway over the next two decades through construction and reconstruction, in line with the needs, thus safeguarding the backbone of the Norwegian power system. Much is uncertain about the future, but we are convinced it will be more and more electric!

Oslo, October 2013

Gunnar G. Løvås
Executive Vice President, Strategy and Public Affairs

Summary

The next generation main grid has now started to become a reality. Construction activity is increasing towards an all-time high.

Statnett launched the development plan for the next generation main grid in 2009. This was a plan to upgrade and invest in new grid capacity – in order to facilitate a reliable security of supply, increased value creation throughout Norway and a more climate-friendly energy sector. Since our last Grid Development Plan was issued in 2011, several matters have highlighted the need for a stronger grid. The next generation main grid has now started to become a reality. Construction activity is increasing towards an all-time high. In 2012, and again in 2013, we have completed and upgraded more than twice as many kilometres of power lines as in previous years.

The need for the next generation main grid has increased

The main grid is ageing

In the 15-year period from the early 1990s, we saw a major increase in power consumption without any corresponding investments in the main grid. Today Norway has one of Europe's smartest and most efficient power grids, with a high utilisation of capacity. Statnett continues to develop smart solutions for operating the power systems of the future, but investments in the physical grid are crucial for the further development of good operating solutions. A considerable share of the current main grid were constructed in the '60s and '70s, and several of our facilities are approaching the end of their life span. The scope of reinvestments needed to maintain a satisfactory operational reliability has become clearer over the last couple of years and is a key driver for the next generation main grid.

A considerable share of the current main grid were constructed in the '60s and '70s, and several of our facilities are approaching the end of their life span.

Security of supply has a high priority

A reliable power supply is one of the pillars of modern society. The Bergen (BKK) area, South Rogaland, Central Norway and Northern Norway all need new transmission capacity to ensure a satisfactory supply. The Grid Report "Report to the Storting No 14 (2011-2012) Building Norway – about grid developments" was presented in February 2012. The report clarifies Statnett's mission in society and provides an overall support for the foundation of our plans. This implies that Statnett should plan investments in the main grid based on the overall principle that a fault in one component should not normally lead to interruptions in the supply (the N-1 criterion). The Grid Report also points out that it will often be better to build too much transmission capacity than too little, and that persistent price differences between regions should be avoided when this makes socioeconomic sense.

The grid generates value

Statnett will make the foundation for value creation by ensuring the required transmission capacity in Norway, supplying electricity to new profitable activities and facilitating increased power trading with other countries. Along the entire Norwegian coast, there are a number of plans for new consumption associated with new power-intensive industry and petroleum activities. New petroleum deposits have been discovered in 2012 and 2013, and there is increasing optimism that further discoveries may be made. Parts of the power-intensive industry are planning to expand over time, in spite of a demanding situation in many product markets.

Statnett's plans will facilitate more than 13.2 TWh of new renewable power production in Norway.

Increased share of renewables requires more grid

By using incentives and support schemes, European, Nordic and Norwegian climate policies make it more profitable for players to invest in new renewable energy production. We have had a single Norwegian-Swedish electricity certificate market since 1 January 2012, where Sweden and Norway each is committed to finance 13.2 TWh. Statnett's plans will facilitate more than 13.2 TWh of new renewable power production in Norway, provided the locations are favourable. The potential for renewable production at competitive costs in Norway is vast, but the costs of the required grid capacity depend to a great extent on where the new power production will be located. Hence, an important duty for Statnett is to inform players on grid development requirements and favourable locations for new renewable production. Western Norway and the county of Nordland have the greatest potential for small-scale power, and Statnett gives priority to facilitating projects in these areas. As for wind-power there is still much uncertainty, both about whether investment decisions will be made, and if so, where the projects will be located.

Several instances of extreme weather, such as the storm Dagmar in December 2011 and several breakdowns in our facilities, have also highlighted the vulnerability of the electricity system and the importance of a strong main grid with sufficient reserve capacity.

System operation challenges

During recent years, new consumption and production records have challenged the power system. With 147.9 TWh, 2012 set a production record for one calendar year. In January 2013, we had both a production record and a consumer record for one hour, with a 26 167 MW production record on 16 January and a 24 180 MW consumer record on 24 January. Import and export records also pose challenges and demonstrate how greater fluctuations in the system will affect operations in the future. System operations need to be adapted to a different flow pattern in line with capacity increases planned for the period up to 2020, both in Norway and towards other countries. Several instances of extreme weather, such as the storm Dagmar in December 2011 and several breakdowns in our facilities, have also highlighted the vulnerability of the electricity system and the importance of a strong main grid with sufficient reserve capacity. To upgrade a grid with a high level of utilisation is a challenge. There is limited opportunity to carry out the required disconnections during the construction period, and system opera-

tion costs can be high. This insight means that we take disconnection plans into account from a very early stage of the project development.

Population growth in urban areas requires coherent grid planning

Developments in general consumption over the next few decades are associated with a high degree of uncertainty. Energy efficiency and new building standards will reduce consumption in some areas, while strong population growth in cities such as Oslo, Bergen and Stavanger – plus the fact that electricity is being used for more and more purposes – will pull in the opposite direction. All in all, we must therefore take into account the possibility for higher electricity consumption in major urban areas.

Future investment levels

Statnett carefully considers costs and benefits for each project, looking for cost-effective solutions. Because our projects have a long development time, changes might occur in consumption and production that alter the socioeconomic profitability of a project. Projects are assessed continuously, so that we can change priorities and release resources for the initiatives that are most important at any given time. To give an example, the Norwegian part of The SydVest Link project was terminated in 2013 because the project was no longer considered profitable. New needs may arise that trigger new projects and initiatives for both the short and the long term.

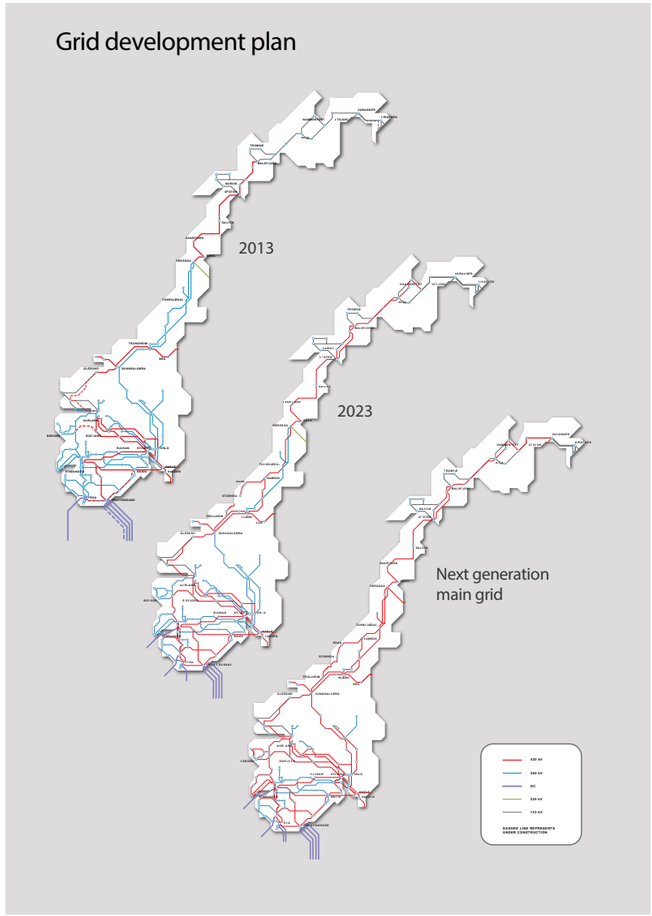
Statnett's plans amount to expected grid investments of NOK 5-7 billion every year for the next ten years. A construction and development capacity corresponding to this investment level will allow us to build a main grid that meets the challenges of the future whilst securing a reliable supply of electricity. As it takes several years to build up or reduce capacity, both for Statnett and our contractors, it is cost-efficient to avoid major fluctuations in investment levels from one year to another.

Statnett's plans amount to expected grid investments of NOK 5-7 billion every year for the next ten years.

According to the plan over the next ten years, the Norwegian main grid will be considerably closer to an entire upgrade with a major increase in capacity. Consequently, the investment level should be somewhat lower in the subsequent decade. There will, however, be a need for reinvestments and upgrades due to the age and technical condition of the facilities, and we will also have some voltage upgrade projects during that period. New needs that might require new investments are also likely to emerge. Large-scale electrification of new petroleum facilities in Northern Norway or new renewable targets, for instance, might trigger grid investments over and above those identified so far. Overall, we expect to see a need for significant investments in that second decade as well, but the annual investment level will probably be somewhat lower than in the coming decade.

Grid development plan

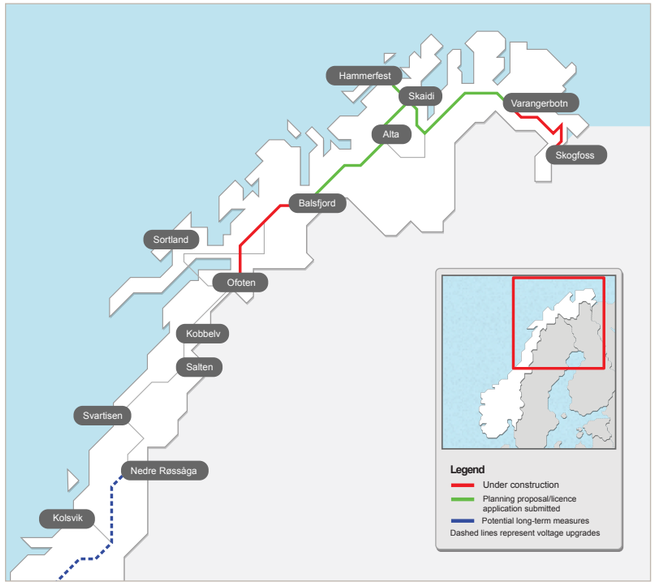
The three maps gives a sketch of the development toward the next generation main grid. The illustration for 2023 consists mainly of specific projects where planning proposal or licence application have been conducted. For the next ten year period there is more uncertainty regarding the progress and socioecenomic benefit of the various upgrade measures.



Grid Development – regional, national, Nordic and European

Grid development in Northern Norway

The present grid does not allow major increases in consumption or production. However, there are high expectations for new oil and gas discoveries with subsequent petroleum activities that might lead to a great increase in consumption.



Main challenges in Northern Norway

Weak security of supply in Troms and Finnmark

During the last few years, the counties of Troms and Finnmark have had more N-0 hours than other parts of the country, and we have seen several fairly lengthy outages. The present grid does not allow major increases in consumption or production. However, there are high expectations for new oil and gas discoveries with subsequent petroleum activities that might lead to a great increase in consumption.

Security of supply is unsatisfactory in Lofoten and Vesterålen

The grid in Lofoten and Vesterålen has a 132 kV voltage level. With a high load and low production in the more distant areas, maintaining the voltage is challenging. Faults have in the last few years led to blackouts in some or all of this area.

Statnett has received a final licence from the Ministry of Petroleum and Energy (MPE) for the 420 kV interconnector Ofoten-Balsfjord, which is 160 kilometres long.

Extensive plans for new renewable energy production

In Troms and Finnmark there are a number of plans for wind-power production as well as hydropower projects. In situations where there is an excess of power, however, the route to consumers will be a long one, and the grid costs will be so high that it is difficult to justify grid development merely on account of wind power. Nordland is currently a major surplus area, with notifications of and licence applications for a great deal of hydropower. We are implementing a number of measures in our substations in order to accept new renewable production, but there is not enough capacity to accept all the new production which has been reported and for which licences are sought.

The next generation main grid in Northern Norway

A new 132 kV interconnector from Varangerbotn to Skogfoss will ensure a reliable supply to South Varanger and elsewhere in Eastern Finnmark. The interconnector entered service in October 2013.

Statnett has received a final licence from the Ministry of Petroleum and Energy (MPE) for the 420 kV interconnector Ofoten-Balsfjord, which is 160 kilometres long. Construction is scheduled to start in 2014, with an expected construction period of three to four years. This interconnector will contribute to a more reliable power supply for the northern part of Nordland and for Troms and Finnmark.

Statnett awaits a final licence from the MPE for the 420 kV interconnector Balsfjord-Skaidi-Hammerfest. The plan to construct a new power line to Skaidi will not be changed, but the progress will be adjusted in line with developments in power consumption. The 420 kV interconnector between Skaidi and Hammerfest will be built when industry in Hammerfest communicates demand for increased capacity and security of supply.

To be at the forefront of developments in power consumption and be able to deliver power to new activity that might start up in Eastern Finnmark, Statnett aims to apply for a licence for the 420 kV interconnector Skaidi-Varangerbotn in the course of 2015.

Throughout the county of Nordland, Statnett is planning new substation solutions and new transformer capacity in order to facilitate plans for new renewable power production and to maintain security of supply. In relation to Statkraft's expansion in Nedre Røssåga and plans for a 420 kV connection, we will submit a licence application in late 2013 for a new 420 kV switching facility in the Nedre Røssåga substation, scheduled for completion in 2016.

Table 1
Project costs are given in 2013 NOK, except from costs for projects under construction which are given in current prices.

We would also like to increase our capacity towards Russia, Finland and Sweden in the north, but have no specific plans for this at the moment.

Northern Norway

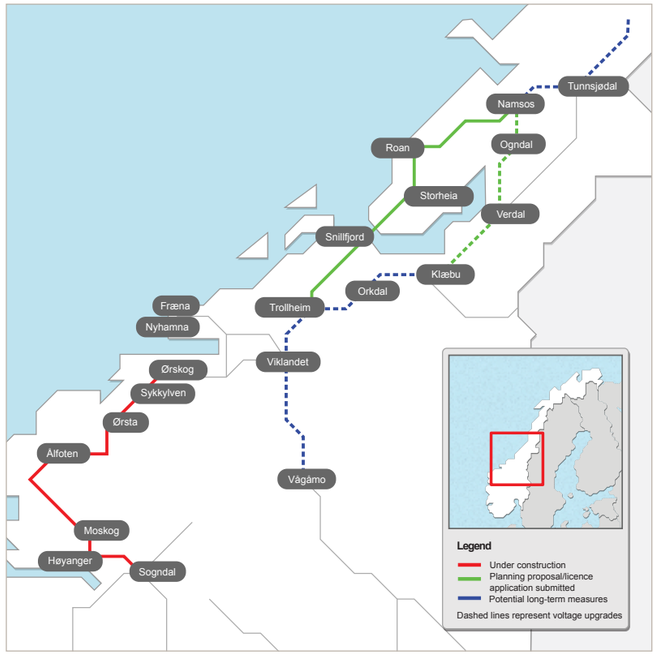
Under construction	Cost interval (NOK)	Approved licence	Expected commissioning	Purpose	Comment
Varangerbotn-Skogfoss, new 132 kV connection	480 - 580	2007	2013-2014	Security of supply	

Planning	Cost interval (NOK)	Expected licensing approval	Time to commissioning after approved licence	Purpose	Comment
Ofoten-Balsfjord, new 420 kV connection	3000 - 4000	2013	3-4 years	Security of supply	Construction startup expected early 2014
Nedre Røssåga-Namsos, voltage upgrade	800 - 1300	2014	4-6 years	RES integration	
Balsfjord-Skaidi-Hammerfest, new connection	5000 - 8000	2014	6-8 years	Security of supply	
Skaidi-Varangerbotn, new connection	2000 - 4000	2017	7-8 years	Security of supply	

Concept evaluation	Cost interval (NOK)	Expected licensing approval	Time to commissioning after approved licence	Purpose	Comment
Lofoten/Vesterålen				Security of supply, new consumption	

Grid developments in Central Norway

On Fosen and in the Snillfjord area, final licences have been granted for wind power projects with a total capacity of more than 1400 MW.



Main challenges in Central Norway

Power balance deficit has led to weak security of supply

This region has at times had higher power prices than Southern Norway, due to a power balance deficit combined with transmission limitations in the grid. The installation of two reserve power plants totalling 300 MW, plus a new 420 kV interconnector to Sweden that came online in 2009, have eased the situation. However, supply will not be normalised until the Ørskog-Sogndal interconnector enters operation in 2016.

Realisation of more renewable energy will lead to new grid investments

There are extensive plans for new wind power production in this region. Profitability depends on support from the electricity certificate market, and the wind power projects therefore aim to be in commercial operation by the end of

2020. On Fosen and in the Snillfjord area, final licences have been granted for wind power projects with a total capacity of more than 1400 MW. The local grid is not designed for large amounts of new power production, and Statnett, at the same time as the wind farms, received a final licence from the MPE for a new continuous 420 kV interconnector from Namsos to Trollheim. No investment decision has yet been made for any of the wind farms, and Statnett is working with the wind power players to coordinate development of the production and grid.

New industry and supply to gas facilities

The Ormen Lange facility receives its electricity from the main grid on Fræna, in practice with a single supply source through a 420 kV power line from Viklandet. A major increase in consumption is planned from the end of 2016. The MPE has requested the operator, Shell, to assess the socioeconomic impact of establishing a bilateral supply to Nyhamna. The assessment will be completed by 1 July 2014. In September 2013, Statnett applied for a change in licensing terms concerning use of the reserve power plant at Nyhamna, so that it may be started up and supply the Ormen Lange gas facility, if a long-term fault should occur in the Viklandet-Fræna interconnector. Statnett will also conduct an independent assessment of what measures are required to secure acceptable supply at Nyhamna when consumption increases.

Increased power flow through the region

New renewable power north of Namsos will also greatly affect the need for transit capacity from Nordland to Central Norway and north-south through this region. Depending on how much production is built, greater capacity might also be required from Central Norway towards Eastern Norway in the longer term.

The next generation main grid in Central Norway

A new 420 kV transmission line between Ørskog and Sogndal is under construction and is scheduled to enter operation in 2016. It will safeguard supplies and facilitate new consumption in Central Norway, and will provide bilateral supply and satisfactory security of supply for Sunnmøre. Six new transformer stations along this section will be crucial for the establishment of any new power production.

The voltage upgrade of the Klæbu-Namsos power line to 420 kV is now taking place, with expected start-up in 2015-2016. The upgrade facilitates integration of new renewable production both in Central Norway and to the north of the region. Together with a possible new 420 kV interconnector from Namsos to Trollheim, it will also give a considerable capacity increase north-south.

On Fosen and in the Snillfjord area, wind power projects with a total capacity of more than 1400 MW have received their final licences. Statnett will prepare for wind farm development by constructing the necessary grid reinforcements once the wind power players have decided to invest. Statnett's plan comprises a three-stage development: First, the Namsos-Roan-Storheia section will be built provided investment decisions for at least 600 MW wind power on Fosen. Then Snillfjord-Trollheim will be built, provided investment decisions for at least 400 MW wind power in Snillfjord. Finally, the interconnector across the Trondheim Fjord (Storheia-Snillfjord) will be installed when the need for transmission in a north-south direction has become sufficiently pressing.

The plan is to upgrade the existing 300 kV interconnector between Klæbu and Aura to 420 kV between Klæbu and Viklandet. This will be necessary if a new 420 kV power line is established between Namsos-Fosen-Snillfjord-Trollheim with associated wind power production on Fosen and in the Snillfjord area.

Table 2
Project costs are given in 2013 NOK, except from costs for projects under construction which are given in current prices.

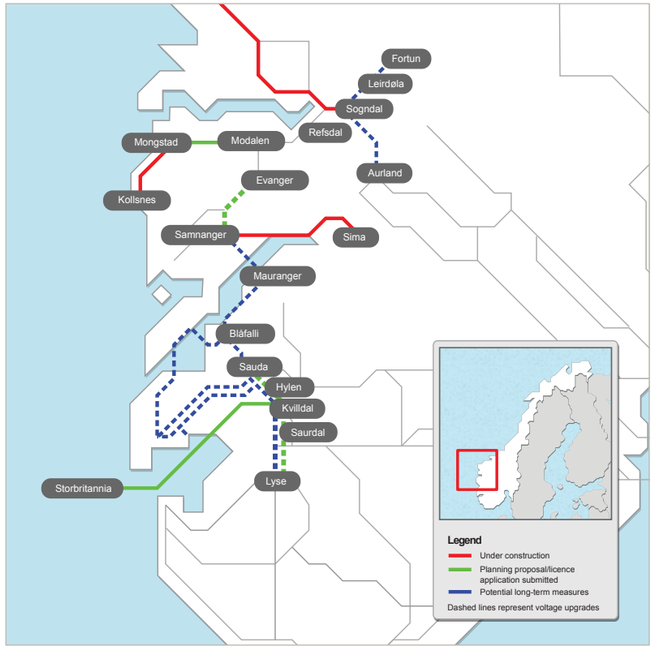
Central Norway

Under construction	Cost interval (NOK)	Approved licence	Expected commissioning	Purpose	Comment
Ørskog-Sogndal, new 420 kV connection	4600 - 5600	2011	2016	Security of supply and RES integration	

Planning	Cost interval (NOK)	Expected licensing approval	Time to commissioning after approved licence	Purpose	Comment
Klæbu-Namsos, voltage upgrade	700 - 1000	2012	4 years	RES integration	
Namsos-Storheia, new connection	1900 - 2700	2013	5 years	RES integration	Approved license
Snillfjord -Trollheim, new connection	1600 - 2300	2013	6 years	RES integration	Approved license
Storheia-Snillfjord, new connection	1900 - 2700	2013	10-15 years	RES integration	Approved license
Klæbu-Aura/Viklandet, voltage upgrade	1200 - 1700	2016	3 years	RES integration and market integration	

Concept evaluation	Cost interval (NOK)	Expected licensing approval	Time to commissioning after approved licence	Purpose	Comment
Fræna/Nyhamna - new consumption load				Security of supply	

Grid developments
in Western Norway



Main challenges in Western Norway

Security of supply to Bergen is not satisfactory

Security of supply in the BKK area is weak at present. The need for import capacity will be solved when Sima-Samnanger enters operation end 2013. The Bergen area and the petroleum industry along the coast, including Kollsnes and Mongstad, will still be without backup if a fault occurs in the grid during high consumption periods. On top of that, the authorities have granted a licence for higher consumption in the gas production on Troll A and on the Martin Linge oil field. Both facilities will be supplied from Kollsnes, and this will significantly increase the need to import electricity into the Bergen area.

Extensive plans for renewable energy require considerable grid investments

There are many plans for both small-scale power and wind power throughout the region. Such new production will need to be in operation by 2020 to be included in the electricity certificate scheme. This provides strong incentives for progressing with the necessary measures in the main grid. Expanding the capacity in the transmission grid will not be sufficient to receive new production; and increased transformer capacity will be required in many main grid substations in Western Norway. The Sima-Samnanger and Ørskog-Sogndal projects will allow for up to 3 TWh new production in the region's main grid. The geographical distribution will to some extent determine how much there is room for before new bottlenecks arise.

Consumption in the SKL area might more than double from the current maximum consumption of about 800 MW. Such an increase would require a major grid upgrade.

Plans for strong growth in consumption by industry and the petroleum industry

On behalf of ten licensees, Statoil has started the licensing process to obtain power from land via Kårstø for the planned developments on Utsira High in 2018. The forecasts presented by Statoil indicate that about 250-300 MW will be required. Hydro launched plans in the spring of 2013 for a pilot plant for new aluminium production technology at its Karmøy factory, requiring around 115 MW with start-up in 2017 at the earliest. The pilot might be expanded to a full-scale plant, and if so, consumption would rise to 500 MW in all, with start-up in 2022-2023 at the earliest.

Combining all plans for this area, consumption in the SKL area might more than double from the current maximum consumption of about 800 MW. Such an increase would require a major grid upgrade.

The next generation main grid in Western Norway

The completion of Sima-Samnanger before the 2013-2014 winter will be very important to secure power import into the region and to facilitate increased production.

When Ørskog-Sogndal is completed in 2016, it will permit a large-scale development of renewable energy in north-western Norway, as six new transformer stations will be installed along the interconnector.

BKK is planning the interconnectors Mongstad-Kollsnes and Modalen-Mongstad. These interconnectors are important to ensure a reliable power supply to the Bergen region and to the petroleum industry along the coast, but they will also allow for new renewable power production. The lines are scheduled to enter operation in 2017.

Statnett is planning to modify the 300 kV power line Sogndal-Aurland to 420 kV voltage. This will increase the transmission capacity southwards from Sogndal, and consequently the existing substation in Fardal will be removed. We are planning to apply for a licence in 2014.

In the summer of 2013, BKK applied for a licence to upgrade the 300 kV interconnector between Evanger and Samnanger. Increased power flow from north to south makes it necessary to upgrade this line.

In addition to the substations that are associated with our power line projects, Statnett is also planning expansions in Leirdøla, Refsdal, Mauranger and Røldal in order to facilitate new renewable production.

Statnett has been working closely with BKK and SKL on how to meet the demand for increased transmission capacity between Sauda and Samnanger. This demand arises due to plans for new production in Western Norway, increased consumption in the SKL Ring, and new international interconnectors. The recommended solution is likely to be an upgrade of the existing line between Sauda and Samnanger.

There are currently plans for reinforcement in the north-south direction, from Ørskog at the northern end to Kristiansand in the south. These reinforcements will be sufficient to facilitate two new international interconnectors as well as any additional renewable production that is triggered by the electricity certificate market.

Table 3
Project costs are given in 2013 NOK, except from costs for projects under construction which are given in current prices.

Western Norway

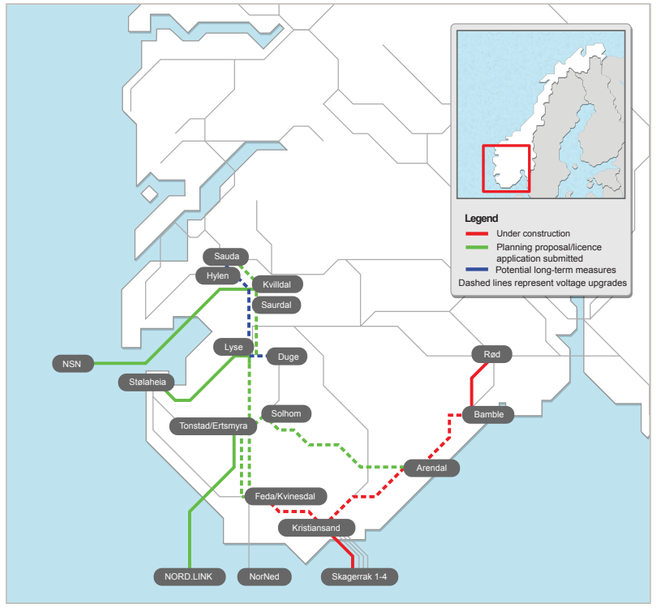
Under construction	Cost interval (NOK)	Approved licence	Expected commissioning	Purpose	Comment
Sima-Samnanger, new connection	900 - 1100	2010	2013	Security of supply	
Mongstad-Kollsnes, new 300 (420) kV connection	1200	2013	2017	Security of supply and RES integration	Project managed by BKK Nett. Approved license.

Planning	Cost interval (NOK)	Expected licensing approval	Time to commissioning after approved licence	Purpose	Comment
Modalen-Mongstad, new 300 (420) kV connection	930	2014	3 years	Security of supply and RES integration	Project managed by BKK Nett. Applied for license.
Aurland-Sogndal, voltage upgrade	500 - 900	2016	3 - 4 years	Security of supply and RES integration	

Concept evaluation	Cost interval (NOK)	Expected licensing approval	Time to commissioning after approved licence	Purpose	Comment
Samnanger-Sauda, voltage upgrade	2000 - 3000	2016	4 - 5 years	Market integration and RES integration	
SKL-Circuit				New consumption	

Grid developments in Southern Norway

Interconnectors to Denmark and the Netherlands causes considerable power transit through the area.



Main challenges in Southern Norway

Security of supply at North Jæren and in South Rogaland is strained

North Jæren, including the Stavanger area, has a significant electricity deficit with a major need for power to be transmitted into the area. The last few years have seen a large increase in power consumption due to an increase in population. Any further increase in power consumption would reduce the security of supply, which is not satisfactory at present.

The area receives power through two 300 kV interconnectors with limited capacity, and the grid is at times operated without an instantaneous reserve. In the event of a fault, many thousand inhabitants might be without electricity until the fault is rectified.

Integration with the Continent has increased the daily fluctuations in production in Norway, with higher production when we are exporting and lower production when we are importing.

Increased transit of power with new interconnectors to Denmark and Germany
The power flow in this area is characterised by transmission to and from the cables to Denmark and the Netherlands. Integration with the Continent has increased the daily fluctuations in production in Norway, with higher production when we are exporting and lower production when we are importing. With one new 700 MW cable to Denmark in 2014 as well as plans for a new 1400 MW interconnector to Germany in 2018 and a new 1400 MW interconnector to England in 2020, the daily flow pattern will grow even stronger. Hence, we see a need for increased north-south capacity in Southern Norway.

Need for increased transformer capacity between regional grids and the main grid
The county of Vest-Agder has limited transformer capacity between the main grid and the regional grid. During periods of deficit in the regional grid, the area relies on transformation of supplies from the main grid. Several recent winters have been cold and dry. Many power plants in Agder have had much less water than normal, and this has made the power supply very vulnerable in the event of a transformer fault. Vest-Agder has a power surplus during summer, and more transformer capacity is needed to receive the new production that is planned. Licences for around 600 MW wind power have been granted in this region over the last few years, but there is great uncertainty as to how many of these projects will be realised. Most of the projects are so large that new transformation to the main grid will be required.

The Eastern Corridor will strengthen security of supply for Southern and Eastern Norway, arrange for industry development and allow for a redevelopment of the regional grid.

The next generation main grid in Southern Norway
The Eastern Corridor project comprises a voltage upgrade of a 140 km interconnector between Kristiansand and Bamble, plus a new 45 km power line between Bamble and Rød. The upgrade is necessary for utilisation of Skagerrak 4, a 700 MW interconnector to Denmark that is scheduled for operation in 2014. The Eastern Corridor will strengthen security of supply for Southern and Eastern Norway, arrange for industry development and allow for a redevelopment of the regional grid.

To strengthen security of supply to South Rogaland and establish two independent interconnectors to Stavanger city, Lyse Sentralnett is seeking a licence for a new 420 kV interconnector between Lyse and Stølaheia. A final licensing decision is expected in 2014-2015, and construction is expected to take three to four years.

The Western Corridor is a complex project consisting of a step-wise power line upgrade to 420 kV from Kristiansand via Feda in the south to Sauda further north. This is required to achieve a high utilisation of Skagerrak 4 and the new high-capacity international interconnectors. The corridor will also provide increased operating margins and facilitate new renewable power production in South and Western Norway. The project consists of three stages and nine licence applications.

Table 4
Project costs are given in 2013 NOK, except from costs for projects under construction which are given in current prices.

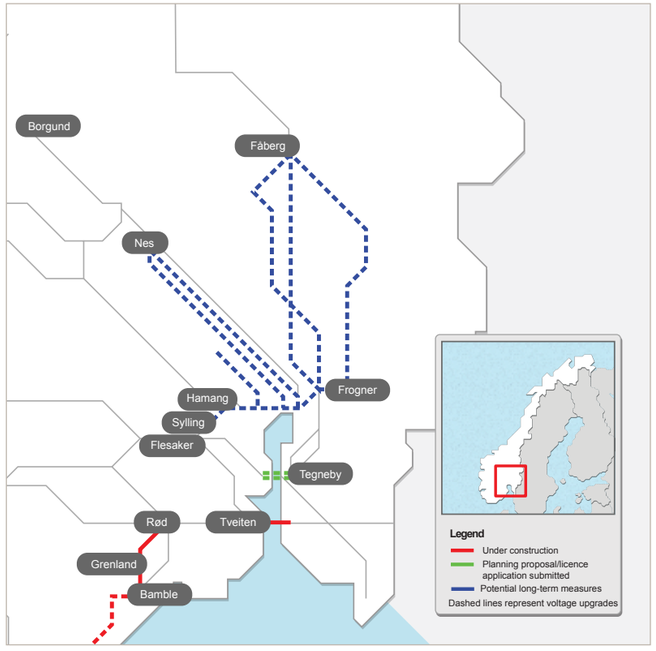
Southern Norway

Under construction	Cost interval (NOK)	Approved licence	Expected commissioning	Purpose	Comment
Eastern corridor, voltage upgrade and new connection Bamble - Rød	1300 - 1600	2013	2014	Market integration and security of supply	

Planning	Cost interval (NOK)	Expected licensing approval	Time to commissioning after approved licence	Purpose	Comment
Lyse-Stølaheia, new connection	2200 - 2500	2014 - 2015	3 - 4 years	Security of supply	Project managed by "Lyse Sentralnett".
Western corridor, voltage upgrade	6000 - 9000	2013 - 2016	4 - 6 years	Market integration and security of supply	Consists of sections in different stages of development

Grid developments in Eastern Norway

Reinvestments and voltage upgrade of existing connections will be essential in order to maintain the security of supply in the area.



Main challenges in Eastern Norway

Ageing grid requires reinvestments

In Oslo and Akershus, several large substation facilities will need a total refurbishment during the coming year due to ageing. These facilities will be built for 420 kV, but will be operated at 300 kV until the further upgrades have been completed. Reinvestments in other facilities throughout this region will also be required.

Population increases in major urban areas require a stronger grid

A strong growth in population and consumption in and around the urban centres in this region leads to more stringent requirements for quality and security of supply. Oslo holds a unique position, with a high consumption and key national functions that depend on a secure and reliable power supply. The Oslo area has

several older transformers, and there is a need for reinvestments, replacement of transformers and grid changes in order to respond to an expected rise in consumption.

Changes in the power flow as a consequence to changes in other areas

With new international interconnectors in Eastern Norway, there will be an increased power flow between the east and the south during some periods of the year. We expect this flow to increase. The amount of new renewable power in Norway and Sweden will affect the flow through Eastern Norway and the Eastern Corridor.

The next generation main grid in Eastern Norway

To safeguard transmission capacity across the Oslo Fjord and security of supply in Eastern Norway, Statnett has started the work of installing new cables in the outer Oslo Fjord, with completion in 2014. Transformer capacity will also be increased in seven transformer stations throughout the region in order to improve security of supply.

In the spring of 2013, Statnett and Svenska Kraftnät decided to terminate the development of the SydVest Link project's western branch between Tveiten near Tønsberg and Nässjö in Sweden. As price differences between Eastern Norway and South Sweden are expected to diminish, the project is no longer considered socio-economically profitable.

The main grid in the area around Oslo is old and has limited capacity, while the population and power consumption are growing. Hence, Statnett started working on the Greater Oslo Grid Plan (NSO) in 2011 in order to find an overall grid solution for the future. Following a concept evaluation, the recommended solution for the main grid in the Oslo area is to upgrade the voltage on the existing interconnectors. A voltage upgrade over a period of 10-20 years is considered to have a robust and positive present value, to increase security of supply and have positive environmental effects.

Table 5

Project costs are given in 2013 NOK, except from costs for projects under construction which are given in current prices.

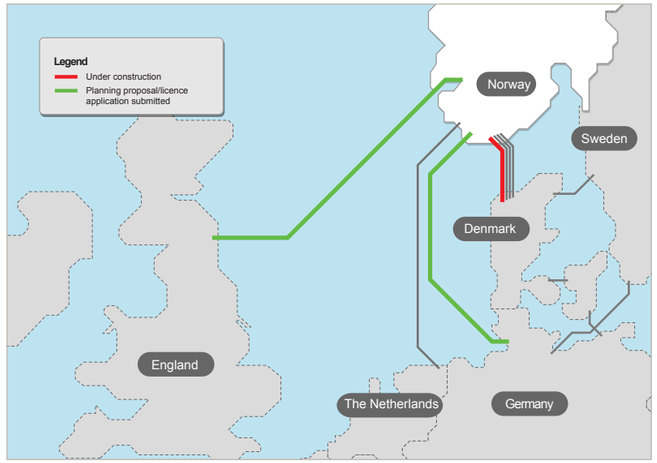
Eastern Norway

Under construction	Cost interval (NOK)	Approved licence	Expected commissioning	Purpose	Comment
Outer Oslofjord (Teigen-Evje), new cables	1200 - 1400	2010	2014	Security of supply	Reinvestment
Transformer capacity Eastern Norway: Follo, Tegneby, Sogn, Vågåmo, Tveiten and Fåberg	680 - 740	2012 - 2013	2015	Security of supply	

Planning	Cost interval (NOK)	Expected licensing approval	Time to commissioning after approved licence	Purpose	Comment
Inner Oslofjord (Solberg-Brenntangen), 420kV cable	580 - 840	2014	2-4 år	Security of supply	Reinvestment
Inner Oslofjord (Filtvedt - Brenntangen) 300 (420) kV cable	575 - 830	2014	2-4 år	Security of supply	Reinvestment
Hamang transformer station	480 - 700	2014	3-4 år	Security of supply	
Oslo grid development project	5000 - 8000	2015 - 2019	2 - 5 år	Security of supply	Cost totals includes planned measures in the coming 10 year period

Closer integration with the Nordic countries and Europe

A key element in the development of the Norwegian main grid is increased market integration through the construction of new inter-connectors to the Continent.



New interconnectors to Denmark, Germany and the UK

A key element in the development of the Norwegian main grid is increased market integration through the construction of new interconnectors to the Continent. Trade with our neighbouring countries has been a financially efficient way of dealing with hydrological fluctuations. European trends go towards more renewable and less thermal power production and a shift in consumption areas, given the new flow patterns which drive the increased balancing needs in Europe.

Our plan is to build a 1400 MW interconnector to Germany in 2018 and a 1400 MW interconnector to the UK in 2020. In addition, a 700 MW interconnector to Denmark is now under construction. It is expected to enter operation in 2014.

Statnett is currently building Skagerrak 4, a new interconnector to Denmark, in cooperation with Danish system operator Energinet.dk. Of the interconnector's 700 MW capacity, 100 MW will be reserved for system services and balancing services for the first five years of operation. The complete subsea cable was installed during the summer of 2013, while some work remains in the land facilities. Commissioning is expected in 2014.

Statnett's projects to Germany and the UK achieved some key clarifications with our overseas partners in 2012, and in May 2013, Statnett applied to the Ministry of Petroleum and Energy for an international licence.

Statnett's projects to Germany and the UK achieved some key clarifications with our overseas partners in 2012, and in May 2013, Statnett applied to the Ministry of Petroleum and Energy for an international licence. Statnett's analyses show that the socioeconomic benefit of increasing our trading capacity is strong and robust.

The Germany project (NORD.LINK) is a collaboration between Statnett and TenneT/KfW. The cable will be connected at Tonstad/Ertsmyra in Sirdal on the Norwegian side and at Wilster in Schleswig-Holstein on the German side. The UK project (NSN) is a collaboration between Statnett and the British system operator National Grid. The cable will be connected at Kvilldal on the Norwegian side and at Blyth on the British side.

Statnett has no current plans to increase the trading capacity over and above the interconnectors to Denmark, Germany and the UK. We do believe, however, that Norway in the longer term, due to its hydropower resources, has the potential to provide Europe with further balancing. One possible concept might be to establish large-scale pump storage in combination with more international interconnectors. This would be technically feasible without any new reservoirs or more extensive regulation. The concept is still considered immature, but has potential for the future. Business models that ensure a positive net benefit for Norway need to be developed further through European collaboration, and so do various technical issues. One of the key factors would be acceptance of the cables taking part in potential capacity markets.

Table 6

Project costs are given in 2013 NOK, except from costs for projects under construction which are given in current prices.

New DC interconnectors from the Nordic system

Under construction	Cost interval (NOK)*	Approved licence	Expected commissioning	Capacity (MW)	Comment
Outer Oslofjord (Teigen-Evje), new cables	1200 - 1400	2010	2014	Security of supply	Reinvestment
Transformer capacity Eastern Norway: Follo, Tegneby, Sogn, Vågåmo, Tveiten and Fåberg	680 - 740	2012 - 2013	2015	Security of supply	

Planning	Cost interval (NOK)*	Expected licensing approval	Expected comissioning	Capacity (MW)	Comment
NORD.LINK: Interconnector to Germany	6000 - 8000	2013 - 2014	2018	1400	License application 2013. Counterpart Tennet and KfW
NSN: Interconnector to the UK	6000 - 8000	2013 - 2014	2020	1400	License application 2013. Counterpart National Grid

*Costs are Statnett's share (50 per cent)

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