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The Norwegian power system. Grid connection and licensing

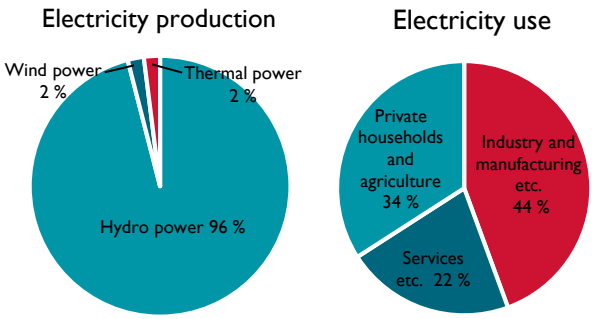
Many data center developers are currently considering Norway as a host country for new sites. This information sheet provides information about the Norwegian power system, the process of connecting new data centers to the grid and connection costs in Norway, as well as links for more information. This information also applies for the connection of new industry.

The Norwegian power grid is a monopoly and regulated by the state. The Norwegian water resources and energy directorate (NVE) regulates the system and grants licences for transmission and production of renewable energy. NVE is a government agency subject to the Ministry of Petroleum and Energy (OED). NVE, the Norwegian electricity grid operators and others receive a lot of questions from industry developers, especially data center developers, related to the Norwegian power system. The purpose of this information sheet is to answer some of those questions.

ELECTRICITY PRODUCTION IN NORWAY

Norway has the highest share of electricity produced from renewable sources in Europe, and the lowest emissions from the power sector. Additionally, more than 75% of the Norwegian production capacity is flexible, and Norway has half of Europe's hydro reservoir capacity.

Access to reasonable priced hydropower has led to a large energy-intensive manufacturing sector in Norway and widespread use of electricity for heating.



Norway is now developing more renewable power production capacity than in the last 25 years. Wind power currently accounts for a relatively modest share of production capacity, but dominates new investments and production is expected to increase.

THE NORWEGIAN ELECTRICITY GRID

The Norwegian electricity grid consists of three levels: the transmission grid, the regional grid and the distribution grid. Most consumers are connecting to the regional or distribution grids. Regional and distribution grids are considered as distribution systems, as defined by EU legislation.

NVE's mandate is to ensure an integrated and environmentally sound management of the country's water resources, promote efficient energy markets and cost-effective energy systems and contribute to efficient energy use.

The directorate plays a central role in the national flood contingency planning and bears overall responsibility for maintaining national power supplies. From 2009 NVE is assigned greater responsibility for the prevention of damage caused by landslides

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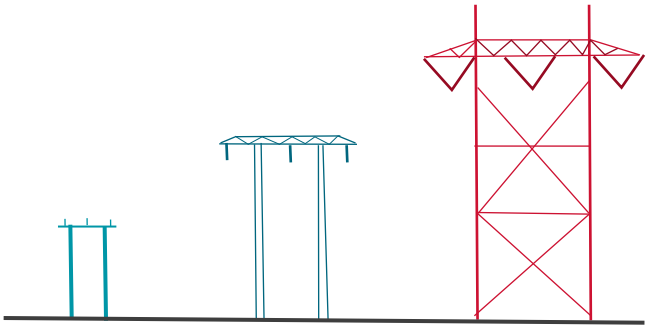
Statnett, the Norwegian TSO, operates the transmission grid, while approximately 130 different distribution system operators (DSOs) operate the regional and distribution grids.



Distribution	Regional	Transmission
≤22 kV	33-132 kV	(132), 300, 420 kV
>300 000 km	19 000 km	12 500 km
Mostly radial	Mostly meshed	Meshed

HIGH CONTINUITY OF SUPPLY

Norway enjoys high security of electricity supply, and the continuity of supply is close to 99,99% in years without extreme weather events. Consumers in Norway experience on average about two short interruptions and two long interruptions per year, where the average duration is less than two minutes for short interruptions and approximately two hours for long interruptions. However, the security of supply varies from region to region and is generally better at higher grid levels.

We recommend you to contact the local DSOs for more detailed information on the security of supply in each region. You will also find statistics in link no. 5 below.

DATA CENTERS MAY TRIGGER GRID INVESTMENTS

A data center may connect at different grid levels, depending on the size of the center. Relatively small data centers with a power demand of approximately 10 MW or less can connect to the distribution grid. If there is available capacity in the overhead grid (regional and transmission grid), a data center may be connected to the distribution grid within a few months by the DSO.

If the data center has a higher power demand, connection to the regional grid may be necessary. New consumption rarely connects directly to the transmission grid. However new consumption may still require grid investments by the TSO, especially if the power demand is high. In these cases, the DSO is responsible for the communication with the TSO. A cluster of large data centers could trigger connection directly to the transmission grid. In those cases, the consumers should contact the TSO directly.

We recommend grid companies to be the licence holder and owner of the grid connection from the data center to the grid.

LICENSING PROCESS FOR NEW GRID

If the data center requires grid investments in the regional or transmission grid, the lead time for grid connection will be longer than for investments exclusively in the distribution grid. DSOs in the distribution grid have area licenses for building, owning and operating electrical assets with voltage levels of 22 kV or less. New grid only requires a local process organized by the DSO.

A new substation or power line in the regional or transmission grid is subject to a licensing process according to the Energy Act. This means that the DSO and/or TSO must submit a licence application to the NVE. The licencing procedure for grid investments for grid level ≤132 kV, and ≥132 kV less than 15 km, is illustrated in the figure below.

The licencing procedure varies from two months to two-three years, depending on the project size, complexity and conflict level. For larger projects, ≥132 kV and ≥15 km, the licencing process may be more comprehensive and with the final decision made by the Ministry of petroleum and energy, and cannot be appealed.

THE DUTY TO SUPPLY ELECTRICITY AND CONNECT NEW CONSUMERS

By law the DSOs and TSO are obligated to offer all customers a grid connection. When necessary this obligation includes planning, applying for licenses and investing in new capacity without any unfounded delay. This obligation is however conditioned by the customer's willingness to pay the connection charge and grid tariffs.

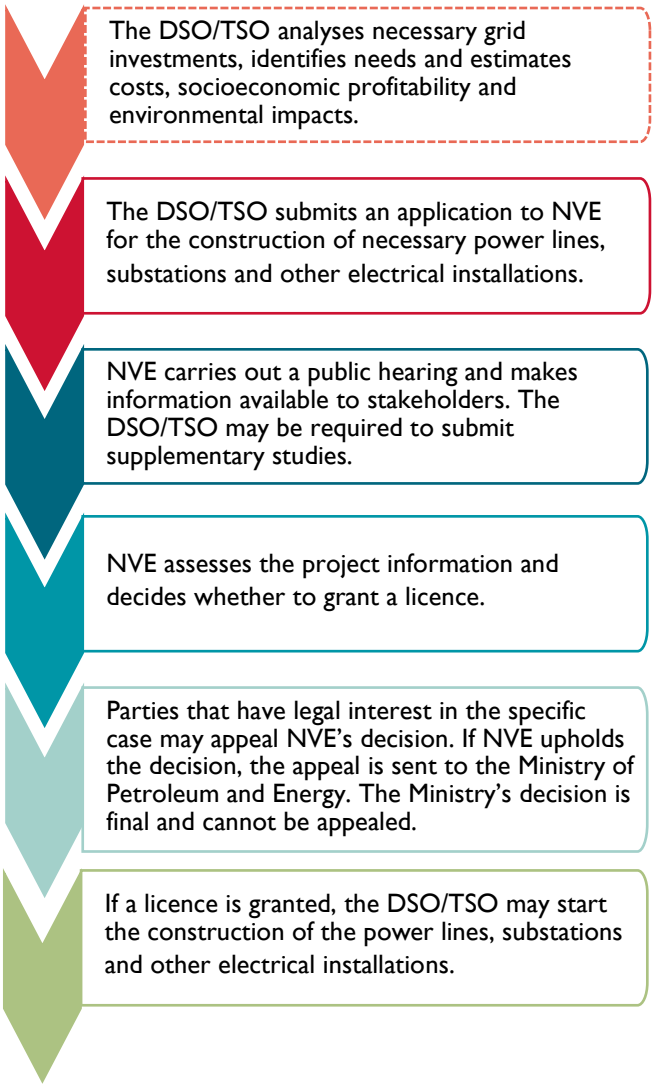


Figure 1: Illustration of licensing process of regional and transmission grid.

COST OF BEING CONNECTED

Connection charge

The DSO and TSO require a connection charge to cover the costs of connecting new customers to the grid, or costs of reinforcing the grid for existing customers. This applies to cost of investments on alle grid levels.

The connection charge is a one-time payment, and the grid company must present an estimate of what the charge will be in advance. The customer must pay the connection charge to be connected to the grid.

Grid tariffs

The grid tariff cover costs for the grid level the customer is connected to, and for the overhead grid. At high voltage local distribution level or regional distribution level, the tariffs are based on two factors: Load and consumption.

The typical tariff for a large consumer would consist of a fixed component determined by maximum power load (NOK/kW), and a variable component determined by power consumption (NOK/kWh).

The grid tariffs vary across Norway as the DSOs are responsible for setting their own tariffs, and the tariffs are covering costs within the DSO's area. However, the grid tariffs must be objective and non-discriminatory, and designed and differentiated based on relevant grid conditions. Some DSOs offer reduced grid tariffs to customers that are willing to cut their consumption in short periods when the local grid is overloaded.

Links to relevant laws and regulations on energy regulation (in Norwegian):

- The Energy Act *(Energiloven)*: *https://lovdata.no/dokument/NL/lov/1990-06-29-50?q=energiloven*
- Energy Act Regulation *(Energilovforskriften)*: *https://lovdata.no/dokument/SF/forskrift/1990-12-07-959?q=energilovforskriften*
- Planning and Building Act *(Plan- og bygningsloven)*: *https://lovdata.no/dokument/SF/forskrift/2017-06-21-854/KAPITTEL_10#KAPITTEL_10*
- Impact Assessment Regulation *(Forskrift om konsekvensutredning)*: *https://lovdata.no/dokument/SF/forskrift/2017-06-21-854/KAPITTEL_10#KAPITTEL_10*
- The law on connection charge: *https://lovdata.no/dokument/SF/forskrift/1999-03-11-302?q=kontrollforskriften*

CONTACT THE DSO FOR MORE INFORMATION

For more information about the opportunities of grid connection, security of supply, interruptions and costs, we recommend you to contact the local DSO or regional grid company in the geographical area of interest. You will find the local and regional DSOs for each geographical area in the links below (link 5 and 10). As a potential new consumer, you can expect to get answers on grid capacity, need for new grid and estimated costs within reasonable time.

We have also listed relevant sources for further information.

RELEVANT SOURCES FOR FURTHER INFORMATION:

1. Facts about the Norwegian energy sector:
   https://energifaktanorge.no/en/
2. Energy Norway's report with information to potential investors in *Location for Data center enterprises in Norway*:
   https://www.energinorge.no/contentassets/513b9d68f343449da61df93ebe7ff66f/locations-for-data-center-enterprises-dce-in-norway.pdf
3. More information on grid regulation, grid connection and grid tariffs:
   https://www.nve.no/energy-market-and-regulation/
4. Online map showing all substations and overhead power lines in the Norwegian electricity grid:
   https://atlas.nve.no/Html5Viewer/index.html?viewer=nveatlas#
5. Map showing each DSO's supply area in Norway:
   https://gis3.nve.no/ferdigkart/omraedekonsesjon_a0.pdf
6. NVE's thematic map service (in Norwegian):
   http://kartkatalog.nve.no/metadatahg_datasett.html
7. More information and statistics on the security and quality of electrical supply in Norway:
   https://www.nve.no/energy-market-and-regulation/network-regulation/quality-of-electricity-supply/
8. Information on NVE's licencing process, laws and regulations (mainly in Norwegian):
   https://www.nve.no/licensing/
   https://www.nve.no/energiforsyning-og-konsesjon/nett/
9. Statnett – Norwegian TSO
   www.statnett.no
10. Overview of regional grid companies, grid development plans and contacts (in Norwegian):
    https://www.nve.no/energiforsyning-og-konsesjon/nett/kraftsystemutredninger/utredningsomrader-og-ansvarlige/
11. The Ministry of Petroleum and Energy:
    https://www.regjeringen.no/en/dep/oed/id750/