

tennet 

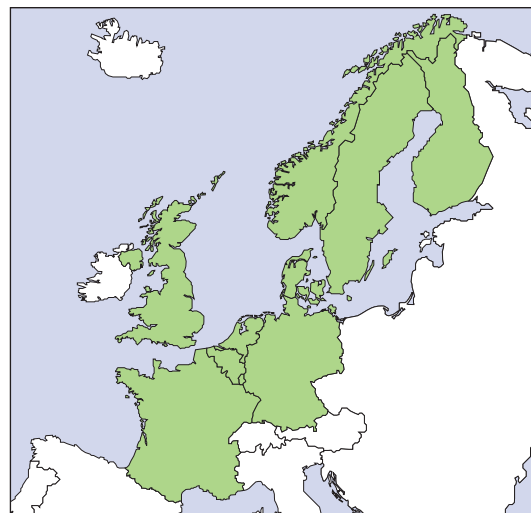
NorNed

Europe's link
for the future



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We take electricity for granted in our everyday lives. Without thinking about it, we turn on lights, let coffee go on percolating and switch the vacuum cleaner into overdrive. But these routine actions would not be possible without somebody to supply the power. In the Netherlands we meet the demand for energy by means of an efficient electricity grid. TenneT is responsible for the national transmission grid.

As the national grid administrator – also known as the Transmission System Operator (TSO) – TenneT rapidly responds to developments in the energy market in Northwestern Europe. A connection between the Netherlands and Norway is in line with the European Union's policy of interconnecting markets and enhancing the free market system.



NorNed in a nutshell

Statnett and TenneT are installing the world's longest submarine high voltage cable between Norway and the Netherlands. In this brochure, you can read all about this extraordinary project.

Statnett and TenneT are the managers of the national high voltage grid in their respective countries, also known as Transmission System Operators (TSOs). Statnett administers the national high voltage grid in Norway, while TenneT is the TSO in the Netherlands. Both organisations take care of the transmission of electricity in their country, from the companies that generate the electricity (the producers) to the customers (regional grid administrators). The NorNed project is a joint initiative of the two TSOs.

What is NorNed?

The NorNed project involves the installation of a submarine high voltage cable which will interconnect the Dutch and Norwegian electricity grids. With a total length of 580 kilometres, the NorNed cable has a capacity of 700 megawatts (MW) – enough to supply power to half of Amsterdam. Via the cable, Statnett and TenneT can transmit electricity from the Netherlands to Norway and vice versa.

Where is the cable located?

The new high voltage interconnection will be installed along the shortest possible route between Norway and the Netherlands. The connecting points will be Fedaa, on Norway's south coast, and Eemshaven in the very north of the Netherlands (province of Groningen). The TSOs will connect the cable to the national high voltage grid in both countries.

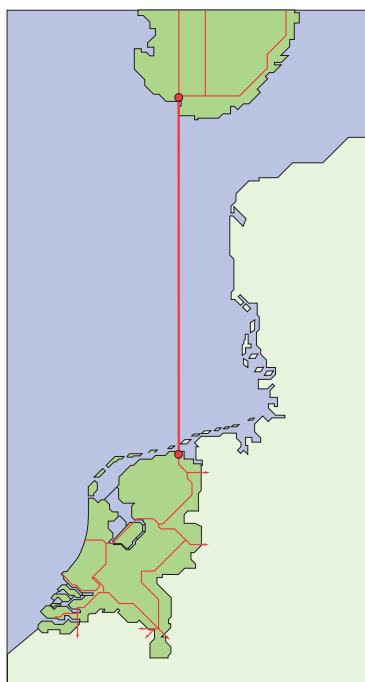


When will the cable be complete?

The NorNed cable is a project that has been long in the making. The first preparations were made as far back as 1994. Execution of the project started in 2005, while the actual installation of the cable commenced in the spring of 2006. The cable is scheduled for commencement of operations in the fourth quarter of 2007. TenneT will announce the exact date on which the cable becomes available for the market on its website.

Why install a new interconnection?

The Dutch electricity grid has important interconnections to Germany and Belgium. Part of the power 'demanded' by the Netherlands originates from abroad. TenneT intends to link the grid to electricity markets to which we are currently not connected. This will help ensure the continued security of supply.



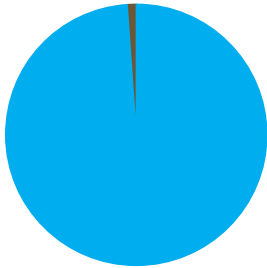
Facts and figures

- cable length: 580 km
- cable capacity: 700 MW
- total project costs estimated at EUR 600 million
- 24 licences in four countries
- 22 agreements with existing cable and pipeline owners
- cable landing points in Fedaa (Norway) and Eemshaven (Netherlands)
- weight of submarine cable:
 - single cable: 37.5 kg per metre
 - double cable: 85 kg per metre
- voltage: +450 kV and 450 kV
- maximum sea depth: 410 m

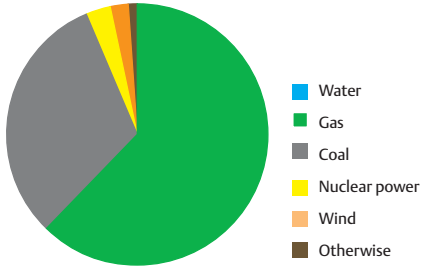
NorNed creates synergy

Electricity production

Norway



The Netherlands



- Water
- Gas
- Coal
- Nuclear power
- Wind
- Otherwise

The cable is wrapped in paper and placed in a process barrel for drying and oil impregnation

The Netherlands is part of the Northwestern European high voltage grid. From an electricity point of view, we are therefore located at the edge of Europe. When the NorNed cable is completed, the Netherlands will occupy a more central position within Europe. In effect, we will be an 'electricity node' connected to other high voltage grids and electricity markets.

Norway and the Netherlands complement each other well when it comes to the production and consumption of electricity. In the Netherlands we consume less electricity at night than during the day, while the energy consumption in Norway is relatively high during the night. The two countries also have different patterns of energy consumption: Norway has an electric heating system, the Netherlands has gas heating.

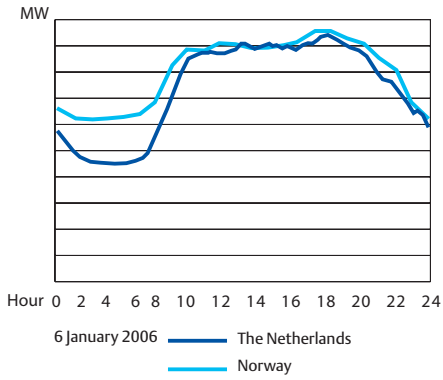
Differences

Norway and the Netherlands also have different methods of generating electricity. In Norway 99% of all electricity is generated through hydro electric power, an environmentally friendly production method. Hydro electric power plants convert the energy of falling water into renewable 'green electricity'.

In the Netherlands, electricity is mainly generated by means of fossil fuels such as natural gas and coal. Via the NorNed cable, Dutch market parties will be able to import renewable electricity. This will mainly be done during the day, when peak moments occur in our electricity consumption.



Electricity consumption in winter

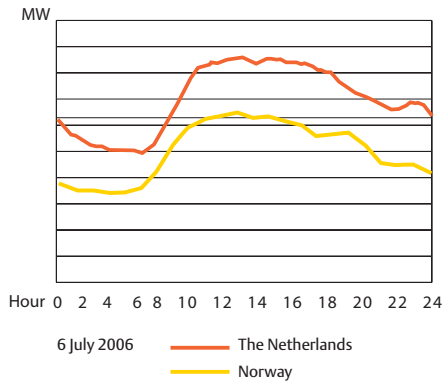


Optimum use of production capacity

Dutch power plants operate at a limited load during the night, because little electricity is used in the Netherlands at night. Electricity cannot be stored, and the generators cannot be switched off, or only partially, because the power plants have to be ready in time for the daily morning peak in electricity consumption. Thanks to the NorNed cable, power plants in the Netherlands will be able to make better use of their production capacity at night by exporting their electricity to Norway.

At night, Norway is self supporting in its electricity production. However, it prefers importing the cheaper electricity produced by the Netherlands during the night. This also allows Norway to save the water in its reservoirs (which are not inexhaustible) for use during the day, so that it can in turn supply electricity to the Netherlands during our expensive daytime peak hours.

Electricity consumption in summer



Cable transport system on the cable ship



Technical aspects of NorNed

The NorNed cable is laid on the seabed and installed from a special cable ship. Converters on the mainland convert the cable's direct current to alternating current and vice versa.

The cable is rolled out in sections which are connected to one another at sea. Each time a section has been installed, a considerable layer of sand will cover the cable in order to protect it. The cable can only be installed in favourable weather conditions (i.e. when the sea is calm).

Facts and figures

Out of the 580 kilometres of cable, we will lay 420 kilometres in shallow waters (up to 50 metres deep). The remaining 160 kilometres of cable will be installed at a depth of up to 410 metres. The double cable weighs around 85 kg per metre; the single cable weighs 37.5 kg per metre. The cable will have a total weight of some 47,000 tonnes. It is being manufactured in factories in Sweden and Norway.

The first 270 km of the cable that connects Eemshaven to Norway consist of a double cable rather than two single cables. In consultation with the Dutch and German authorities, Statnett and TenneT opted to use a double cable in this part of the sea, partly to protect the maritime environment. For reasons of efficiency, two single cables were installed in the deeper parts of the sea.



From direct current to alternating current

The NorNed cable is a direct current connection. Due to energy losses, the use of alternating current is not efficient when transmitting power across a distance of several hundreds of kilometres. The mainland high voltage grids in Norway and the Netherlands transmit alternating current, however. This means that large 'converters' are required to convert the direct current into alternating current. Both in Feda (Norway) and in Eemshaven (the Netherlands), these converters will be set up at high voltage substations. Each converter takes up a lot of space, equal to the size of approximately two football pitches.

Adapting substations

TenneT will modify the existing high voltage substation at Eemshaven: a separate connection will be installed, as well as an additional transformer. Additionally, a new converter station was built at a few kilometres distance from the existing high-voltage substation. The weather conditions in Eemshaven make it necessary to place the converter indoors, as salty wind and wind blown sand may damage the equipment. The converter in Feda will mainly be set up outdoors, because Feda is located about 60 km inland, by a fjord.

A strong European electricity market

The NorNed cable will link up the electricity grids of the Netherlands and Norway. In the longer term, this submarine cable link will also make a significant contribution towards a strong European electricity market comprising central Western Europe and the Scandinavian countries.

From the end of 2007, this new 'electricity highway' will allow market parties to import and export electricity to and from Norway and the Netherlands. To enable trading via the NorNed cable, market parties will purchase both electricity and capacity (i.e. 'space' on the 'highway').

Temporary explicit auction system

Statnett and TenneT will make the entire capacity of the NorNed cable available to the market. During the initial period, this will be done by means of an explicit daily auction jointly organised by Statnett and TenneT. Bids are submitted electronically by the market parties. Statnett and TenneT will inform the participating market parties of the auction results and publish them on the website www.norned-auction.org.

Market coupling

In the market coupling or implicit auction system, a market party simultaneously buys capacity and electricity on one of the electricity markets. The TSOs will allow free access to the NorNed cable whenever possible. Harmonisation of the Gate Closure Times (GTCs) in the participating countries is a precondition for market coupling. The GTC is the



'deadline' for submitting next-day bids on the day-ahead market. At the moment, the closure times of some European exchanges still differ from one another. The same applies to the electricity prices in the various countries. Linking up electricity exchanges will result in a convergence of prices, and will allow countries to make better use of the available capacity.

European collaboration

In June 2007, five European countries (Belgium, Germany, France, Luxembourg and the Netherlands) signed a so-called Memorandum of Understanding (MoU). This joint statement of intent deals with the coupling of electricity markets and the security of supply in Central Western Europe (CWE). The Memorandum was signed by the responsible government ministers and representatives of regulatory authorities, TSOs, electricity exchanges and market parties.

Statnett and TenneT expect that market coupling with the Northern European spot market can be realised once the CWE regional market has been established. It will then be possible to conduct implicit auctions between the Netherlands and Norway, and extend the market coupling system to neighbouring countries as well.

Benefits of the NorNed cable

Several parties in Norway and the Netherlands will benefit from the NorNed cable, including society at large, the energy market, electricity users and TSOs. Both Statnett and TenneT feel these benefits justify the considerable costs of the installation of the cable.

Benefits for TSOs

The main benefit TenneT and Statnett will reap from the NorNed cable is that it will help the TSOs safeguard the security of electricity supplies in the Netherlands and Norway. Both TenneT and Statnett will strengthen their positions in the North-Western European power market. Furthermore, the cable will enable Dutch power stations to make better use of their production capacity at night, as Norway's peak electricity demand occurs at night.

Benefits for the market

Purchasing electricity in the price area of the Netherlands is expected to become cheaper. The supply will increase while the demand for energy will remain the same. Basic economic principles dictate that prices will drop in such a situation.



Benefits for society

Thanks to the NorNed cable more international trading will take place. The NorNed cable will contribute to more stable electricity prices in Northwestern Europe, because the electricity prices in Norway and the Netherlands are expected to converge. The electricity prices determined on an hourly basis by APX and Nord Pool Spot will fluctuate less. This will in turn result in a more stable overall electricity price.

Benefits for end users

The purchase price of electricity in the Netherlands is expected to drop slightly. End users (e.g. consumers and businesses) will eventually profit from this development because they will be charged a lower price for each kilowatt hour (kWh) of electricity.

NorNed and the environment

During the installation of the NorNed cable, Statnett and TenneT will be taking careful account of the vulnerable natural environment in which the submarine high voltage cable is being laid, for instance with regard to the plant and animal life in the Waddenzee area.

TenneT and Statnett are aware of their responsibility towards society. All new high voltage lines and cables are integrated into their environment as well as possible. When installing the NorNed cable, they take account of the wishes of government bodies, interest groups, businesses and local residents.

Preconditions

The route and location of the NorNed cable depend on various aspects:

- Environmental planning/preconditions (environmental considerations, locations of nature reserves, shipping routes)
- Electrical/technical preconditions (strength of the magnetic field, soil condition)
- Organisational preconditions (costs, timeline)
- Policy frameworks defined by the government (spatial planning, legislation)

Consultation

Part of the NorNed cable runs through the Waddenzee. This is a marine area where plant and animal life receive a great deal of attention. The exact route of the submarine high voltage cable is determined in consultation with government bodies and interested parties.

Coast of the Waddenzee near Eemshaven





Colofon

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tennet 

Utrechtseweg 310
6812 AR Arnhem
PO Box 718
6800 AS Arnhem
The Netherlands

Telephone +31 26 373 1111
Fax +31 26 373 1112
E-mail servicecentrum@tennet.org
Website www.tennet.org