NEPP
north european power perspectives

Results

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Increase in Nordic electricity export towards 2030

- selected results from recent studies

Several recent research studies have shown the potential for significantly increasing net electricity export from the Nordic countries to Continental Europe towards 2030. A possible span of 0-60 TWh annually is reported in this synthesis sheet. Thus, depending on driving forces and preconditions the outcome may be quite different. The aim of this text is to assess a number of important driving forces and to identify their impact on the electricity trade between the Nordic countries and Continental Europe.

The main reasons for inreased Nordic electricity export are mainly the cost- and climate-efficient existing supply capacity and the comparative advantages for new renewable electricity generation in the Nordic countries.

The future development of the Nordic electricity supply system is in many research studies characterized by an increase in renewable and nuclear electricity generation and a gradual phase-out of fossil generation. The driving forces for such a development are, above all, international as well as domestic renewable and climate policies. Furthermore, the estimated balance between production and demand in the Nordic countries implies a potential for significantly increasing net electricity export from the Nordic countries to Continental Europe. Due to the cost- and climate efficiency of the Nordic electricity supply, such a development would be beneficial for the entire North European region.

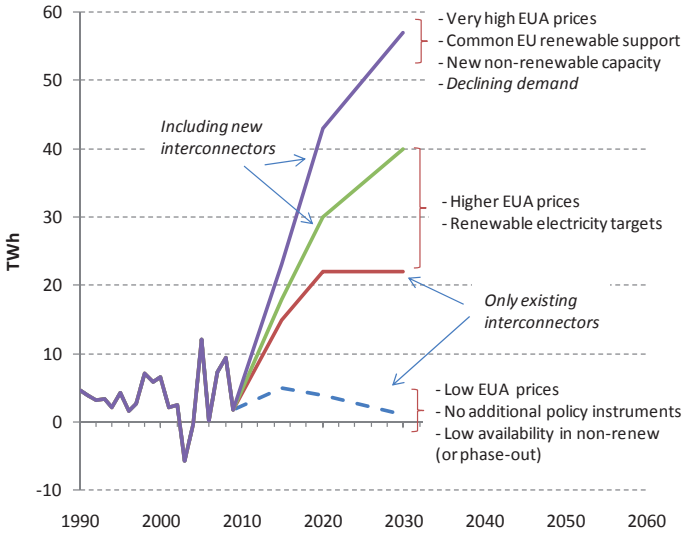

Figure. Net electricity export from the Nordic countries to Continental Europe (Germany, Poland, the Netherlands and Estonia) historically and as estimated by the studies included in the reference list below (Source 1990-2009: ENTSO-E and Nordel)

Prospects for a Nordic net electricity export

Even though existing interconnectors may accommodate a relatively large share of a Nordic net export, the decisive impact is likely to occur through new interconnectors. The figure below summarizes the investigated studies and their estimates on future Nordic electricity exports. It is shown that by 2020 more than 40 TWh may be net exported to Continental Europe if conditions are favourable. By 2030 this figure may approach 60 TWh per year.

Important driving forces and preconditions

The research studies dealt with here have identified a number of important driving forces for increasing Nordic net electricity export:

- Differences in existing and new supply structure between the Nordic countries and Continental Europe leading to long-term marginal-cost differences (see coming section)
- An ambitious European climate and renewable policy. The higher the EU ETS price gets, for example, the more competitive Nordic electricity generation becomes. This is also true for a large share of fossil electricity supply, since it, mainly consists of relatively efficient combined heat and power schemes in the Nordic countries.
- A common European renewable electricity target is likely to imply a larger need for Nordic electricity export than if renewable targets are to be met domestically. A common scheme means that countries with high marginal costs for renewable electricity generation need to produce less than otherwise in exchange for those countries with lower costs, assumably the Nordic countries, take on a relatively larger share.
- Increased importance of cross-border power/capacity trade. The latter may imply a certain impact on the dispatch of hydro power and will be further investigated in the NEPP project.

Apart from such driving forces a number of important preconditions must also be considered for a large (>20TWh) Nordic net export to take place by 2020-2030:

- New interconnectors must be built with relatively short lead times

- Maintaining and upgrading nuclear power. Phasing out non-renewable electricity generation will reduce the potential for net electricity export
- Public acceptance to increased electricity production in the Nordic countries for the benefit of the European electricity system. A significant increase in exploiting wind resources, for example, will probably not happen without certain local intervention.
- Domestic grids must be reinforced. To what extent an increased Nordic net export is affected e.g. by the German electricity grid will be further investigated in upcoming studies.

Finally, the potential for net export may be further boosted by reduced electricity demand in Northern Europe.

New and existing interconnectors

Investments in new interconnector capacity between the Nordic countries and Continental Europe have been estimated to around 4,5 GW by 2025 using the MARKAL-NORDIC model in an ambitious climate-policy regime (Vision 2050, commended by Swedenergy). In a corresponding scenario during the Pathways project and based on ELOD model runs, the estimate was somewhat less but still above 4 GW. Such interconnector capacities correspond to the upper limits of the shown net exports in the former figure. Total existing interconnector capacity available for Nordic export is around 4,2 GW. If these cables could be fully utilized the potential for exporting from the Nordic countries amounts to roughly 35 TWh. However, due to e.g. domestic grid limitations, reserve margins maintenance and interruptions the capacities are not fully utilized. The maximum flow (adding import and export to and from the Nordic countries) through these interconnectors have, hitherto, been approximately 20 TWh per year (ENTSO-E statistics)[1)]. However, interconnector capacities between the Nordic countries and Continental Europe also have to consider annual variations in precipitation leading to significant variations in hydro power and, thus, in total Nordic electricity production. This is also an important reason why the interconnector capacity may seem somewhat "underutilized", at least during normal year conditions.

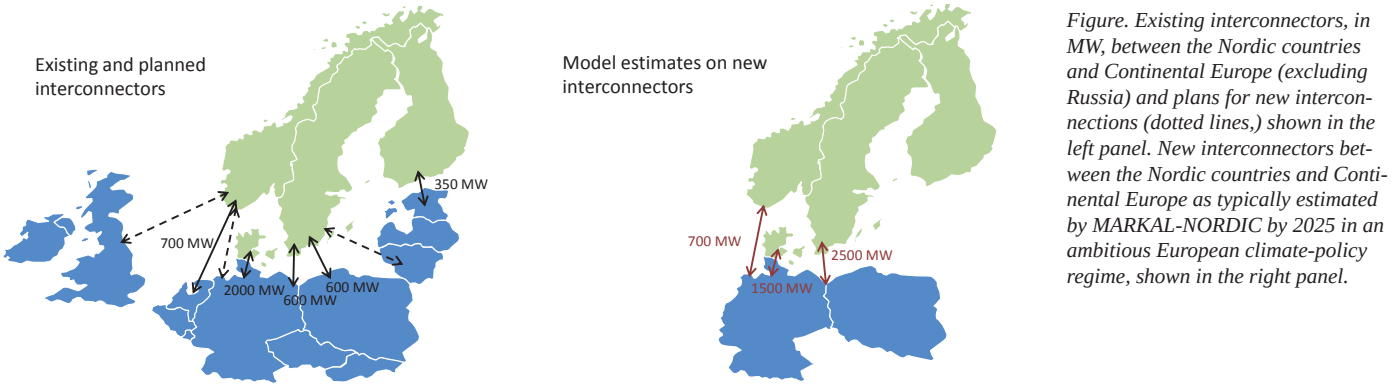

Figure. Existing interconnectors, in MW, between the Nordic countries and Continental Europe (excluding Russia) and plans for new interconnections (dotted lines,) shown in the left panel. New interconnectors between the Nordic countries and Continental Europe as typically estimated by MARKAL-NORDIC by 2025 in an ambitious European climate-policy regime, shown in the right panel.

Huge challenges for national grids

The increase in net electricity exports from the Nordic countries indicate that the expansion of renewable electricity generation poses a huge challenge for TSOs. The description of the system in 2020 shows increased transit, particularly through Sweden and Denmark, increased intermittency as the share of wind power increases, and reduced flexibility on the supply side as the share of conventional power generation is reduced. The challenge for the electricity grid and for transmission system operators is amplified by the relatively large amounts of intermittent wind power that we can expect as a result of renewable policies, especially if trade in renewable certificates and increased interconnector capacity is made available. Such a development will also affect existing thermal power plants with a likely increase in generation swing and the number of annual starts and stops. Large volumes of wind power (and other intermittent production) will, therefore, also require a higher degree of flexibility on the demand side, e.g. from electric boilers, both at the end user side and in district heating, and electric vehicles and other means for temporarily storing electricity.

INCLUDED STUDIES AND MODEL APPROACHES

The NEP project, 2007-2010:
- Global TIMES by VTT, Finland
- ECON-Classic model by ECON Pöyry, Norway
- MARKAL-NORDIC model by Profu, Sweden
- Balmorel model by RAM-løse edb, Denmark

The Pathways project, 2006-2011:
- ELOD/ELIN model by Chalmers, Sweden

Assessing a common Swedish-Norwegian electricity certificate scheme, study commended by the Swedish Energy Agency in 2010:
- MARKAL-NORDIC model by Profu, Sweden

Vision 2050, study of the future Swedish and Nordic electricity-supply system commended by Swedenergy in 2010:
-MARKAL-NORDIC model by Profu, Sweden.

[1)] *A Nordic export of around 20 TWh with existing interconnectors would, thus, imply a zero import which is rather unlikely*

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