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Nordic Energy Technology Perspectives (Nordic ETP)

Nordic Energy Technology Perspectives is the first ever regional edition of the IEA's renowned global publication Energy Technology Perspectives. While based on the same global scenarios to limit average temperature increase to 2°C, the Nordic edition includes an even more ambitious Carbon-Neutral Scenario, exploring how the Nordic countries can achieve their national emission reduction targets for 2050.

The Carbon-Neutral Scenario calls for a complete decarbonisation of Nordic electricity generation. Improvements in grid infrastructure will be important in facilitating this, and with the right pricing in place, the Nordic region could achieve annual electricity exports of 50 to 100 TWh over the longer term. Existing Nordic hydropower resources can play an increasingly important role in regulating the North European power system.

Achieving the required 7% drop in energy demand between 2010 and 2050 requires significant energy efficiency improvements in buildings, industry and transport. Average energy use per square meter in buildings must drop by 35% from current levels. The necessary reductions in industrial emissions rely on Carbon Capture and Storage (CCS).

Transport will require the greatest emission reductions of any sector, to just an eighth of its current level by 2050. To achieve this, sales of electric vehicles must double every year for the next decade. Biofuels will underpin freight transport, accounting for half of energy use in all Nordic transport in 2050.

The region could become a net importer of biomass, highlighting the need to secure a sustainable supply and the potential for Nordic technology development in the area.

The project is a cooperation between the IEA, leading research institutes from Sweden, Denmark, Finland, Iceland and Norway, Nordic Energy Research and the Nordic Council of Ministers. NEPP has been the Swedish partner in the Nordic ETP working and reference group.

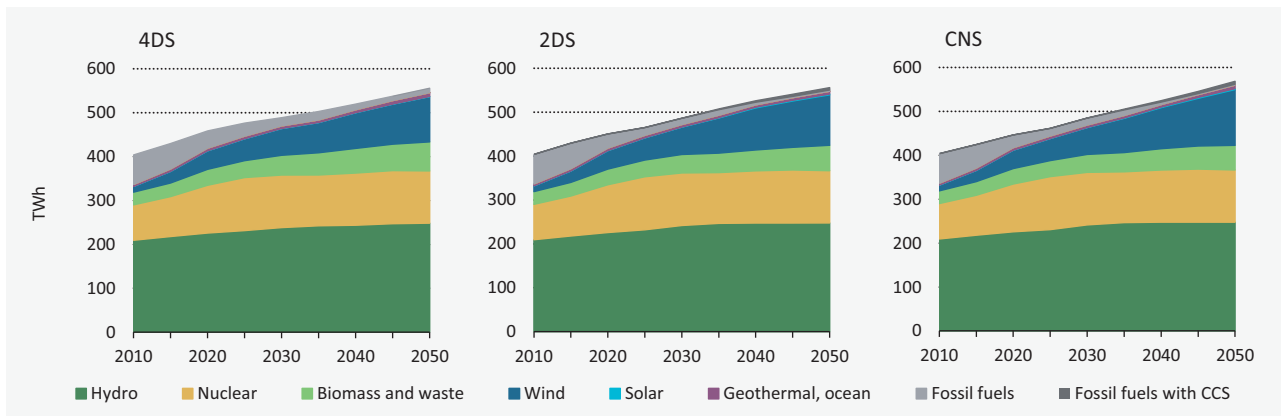
A near complete decarbonisation is possible – but very challenging

In the IEA global 2°C Scenario (2DS), energy-related CO₂ emissions in the Nordic region must be reduced by 70% by 2050 compared to 1990. But the Nordic countries have set their ambitions higher, aiming for even deeper cuts, and for some countries, a carbon-neutral energy system by 2050. These ambitions are operationalised in the Carbon-Neutral Scenario (CNS), in which energy-related CO₂ emissions are reduced by 85%. The remaining 15% are assumed to be offset by international carbon credits. The Nordic countries are in a strong position to establish a low-carbon energy system, thanks to rich renewable energy resources and relatively progressive policies already in place.

To realise the Carbon-Neutral Scenario, Nordic electricity generation needs to be fully decarbonised by 2050. Wind generation needs to grow quickly and alone accounts for 25% of electricity generation in 2050. This will increase the need for flexible generation capacity, grid interconnections, demand response and storage. Total investment required in the power sector is equal to some 0.7% of cumulative GDP over the period.

All industrial sectors must contribute. Energy efficiency and carbon capture and storage (CCS) will be vital to achieve the necessary emission reductions. By 2050, the overall energy intensity of the Nordic economies falls by some 60% from 2010 levels. This requires industrial use of fossil fuels to be cut in half and relies on CCS for further cuts. Current uncertainty over national positions on CCS must be resolved for this to happen.

CO₂ emissions associated with the buildings sector must be reduced by 80% by 2050. Widespread retrofits of older building stock will be necessary to achieve the necessary energy efficiency improvements. In the short term, policies should focus on improving building shell performance and on requiring best available technologies for space heating and cooling.



Growth in electricity generation in all scenarios is covered by low-carbon electricity sources, mainly renewables

Transport sees the most dramatic drop in emissions of all end-use sectors, from 80 MtCO₂ in 2010 to some 10 MtCO₂ in 2050. This will require limiting growth in transport demand, substantial technology cost reductions, securing a sustainable biofuel supply and intelligent modal shifts. Improved fuel economy provides the majority of transport emission reductions through 2030, with biofuels and electric vehicles more important in the longer term. By 2050, average fuel consumption of new cars must decrease to about 3 L/100km, down from 7 L/100km in 2010. Plug-in hybrid and battery electric vehicles must reach 30% of total sales in 2030 and 90% in 2050. Long-haul road freight, aviation and shipping remain dependent on high energy density liquid fuels even in 2050, resulting in an increased use of biofuels.

An interconnected European energy system

A highly interconnected European energy system will facilitate decarbonisation and could offer large economic opportunities for the Nordic countries.

- Decreasing costs for low-carbon electricity generation, coupled with a reinforcement of grid interconnections, could make the Nordic region a major net exporter of electricity. The Nordic region could achieve annual exports in the range of 50 TWh to 100 TWh over the longer term.
- The Nordic hydropower resource will be increasingly valuable for regulating the North European power system. An increasingly efficient and flexible Nordic power grid could enable a quicker decarbonisation of the European energy system. Transmission capacity needs to be strengthened in order to facilitate this.
- Supplying the region's growing demand for biomass will rely on a well-functioning international market. In the Carbon-Neutral Scenario, bioenergy use increases by two thirds to become the largest energy carrier. This highlights an opportunity for research in sustainable biofuels to increase domestic production.

Five central challenges

The Nordic ETP identifies five central challenges that the countries face in a carbon-neutral energy system.

- **Energy efficiency improvement remains a priority policy area.** Policies to ensure rapid and sustained energy efficiency improvements will be necessary in all scenarios, especially in buildings and industry.
- **Infrastructure development will be a critical policy challenge.** The significant need for new infrastructure in electricity grids and generation will not only pose technological and financing challenges, but will also require social acceptance.
- **Carbon capture and storage (CCS) plays an important role, especially in industry.** Progress in this technology has been slow and uncoordinated between countries. Governments must scale-up policy action for this technology to realise its full potential.
- **Bioenergy will be the single largest energy carrier in 2050,** raising questions over its supply. The Carbon Neutral Scenario projects a net import of bioenergy to the Nordic region, making sustainability criteria all the more important.

For further information: Håkan Sköldbberg, Profu