Nordic Energy Technology Perspectives

At a glance

Nordic Energy Research

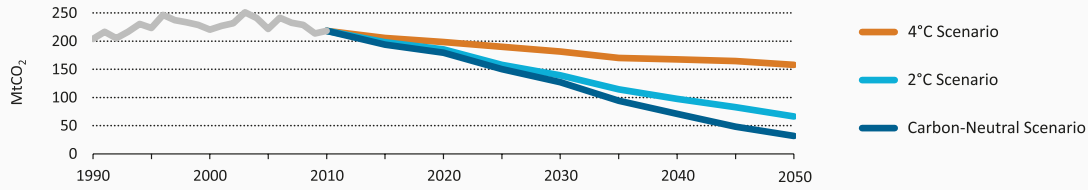
International Energy Agency

Nordic Energy Technology Perspectives describes how the Nordic countries can meet their national climate targets and achieve a carbon-neutral energy system by 2050. This regional scenario is even more ambitious than the global 2°C Scenario from the IEA's Energy Technology Perspectives 2012, which is designed to limit average global temperature increase to 2°C.

In the global 2°C Scenario, energy-related CO_2 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, in which energy-related CO_2 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.

Scenarios

Nordic energy-related CO_2 emissions



Note: The 4°C Scenario represents a future in which strategic action limits global average temperature increase to 4°C; The 2°C Scenario reflects more aggressive approaches to limit the rise to 2°C; The Carbon-Neutral Scenario depicts even greater emission reductions within the Nordic region, with the rest of the world as in the 2°C Scenario.

A near complete decarbonisation of the Nordic energy system is possible – but very challenging.

To realise the Carbon-Neutral Scenario, Nordic electricity generation needs to be fully decarbonised by 2050. Wind generation needs to grow particularly 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 – to just 20% – and relies on CCS for further cuts. Current uncertainty over national positions on CCS must be resolved for this to happen.

Transport sees the most dramatic drop in emissions of all end-use sectors, from 80 $MtCO_2$ in 2010 to some 10 $MtCO_2$ in 2050. This will require limiting growth in transport demand, substantial technology cost reductions, securing a sustainable biofuel supply and intelligent modal shifts.

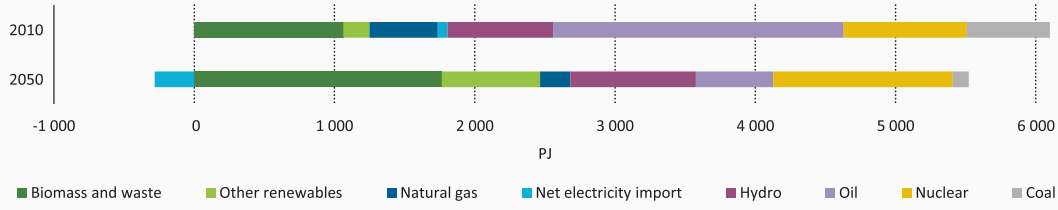
Improved fuel economy provides the majority of transport emission reductions through 2030, with biofuels and electric vehicles more important in the longer term. By 2050, average fuel consumption of new cars must decrease to about 3 L/100km, down from 7 L/100km in 2010. Plug-in hybrid and battery electric 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.

CO_2 emissions associated with the buildings sector must be reduced from 45 $MtCO_2$ in 2010 to less than 10 $MtCO_2$ in 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.

A systems approach will make transforming the energy system easier and cheaper. Nordic countries have already taken important steps in this direction.

Changes in energy demand and supply must be considered simultaneously across multiple sectors. Complete decarbonisation of electricity is the most central, system-wide change and has large spill-over effects for end-users. A high share of variable electricity generation requires extensive system integration. Substantial synergies are evident among systems for district heating, power generation, electric transport, municipal waste management and industrial energy use.

Projection Nordic Total primary energy supply in the Carbon-Neutral Scenario



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. With the right infrastructure and pricing in place, the Nordic region could achieve annual exports 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 at some 1 700 PJ annually. This highlights an opportunity for research in sustainable biofuels to increase domestic production.

Nordic Energy Technology Perspectives at a glance

The five Nordic countries of Denmark, Finland, Iceland, Norway and Sweden have announced ambitious goals towards decarbonising their energy systems by 2050. Based on the scenarios and analysis of Energy Technology Perspectives 2012, the International Energy Agency (IEA) and leading Nordic research institutions jointly assess how the Nordic region can achieve a carbon-neutral energy system by 2050.

Without doubt, the Nordic countries are front-runners in taking decisive action toward clear, long-term energy targets. In examining their approach, this project aims to provide objective analysis that will increase the Nordic region's chances of success. A secondary – but ultimately more important – aim is to prompt other countries and regions to follow their lead.

The report identifies five central challenges that the Nordic countries face in achieving a carbon-neutral energy system. Other countries seeking to radically transform their energy systems should take note.

- **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.
- **Nordic co-operation is a prerequisite to reducing the cost in achieving the scenarios.** Regional co-operation in infrastructure development, RD&D and in strategies for transport and CCS would offer significant benefits.

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