European Commission

Science for Environment Policy

Nordic countries demonstrate the potential of low-carbon energy policies

How are Denmark, Finland, Iceland, Norway and Sweden moving towards renewable and lower-carbon energy use? A recent study suggests the key areas for progress, to ensure Nordic countries meet low carbon goals, include more renewable and decentralised electricity supply, the development of low-carbon transport systems, improved energy efficiency in building design and industrial use of carbon capture and storage.

Denmark, Finland, Iceland, Norway and Sweden have ambitious energy and climate policies to be practically 'fossil free' by 2050. Denmark, Norway and Sweden are committed to 100% renewable energy use, whereas Finland has a target of 80% and Iceland of 50–75%. These policies rely on renewable energy and energy-efficiency technologies, a field in which these countries are leaders — Denmark in the use of wind energy, Finland and Sweden for bioenergy, Norway for hydroelectricity and Iceland for geothermal energy. As a result, carbon dioxide (CO_2) emissions from energy supply have been declining in the region over recent decades. For example, electricity generated across the Nordic region is already 87% 'carbon-free'[1]; 63% of this is from renewable sources.

This study examined policy actions and challenges related to the energy transition in the Nordic countries. The researcher primarily used information from research reports on Nordic energy produced by the International Energy Agency (IEA), which models the most economical ways for Nordic countries to be fossil free by 2050. The IEA looks at different aspect of energy supply and energy sectors, including energy conversion, industry, transport and buildings.

The researcher acknowledges that, as within any modelling approach, the IEA methodology is subject to uncertainties and is not able to account for certain realities such as the political situation or public acceptance. Neither does it account for potential innovations or developments in existing technology. However, the researcher describes the methodology as a state-of-the-art model, which is a useful tool in understanding the optimisation of energy supply from non-fossil fuel sources.

The study provides five key findings in relation to low carbon transition:

1. The Nordic countries demonstrate the reliability and positive cost balance of renewable and low-carbon energy systems — the researchers say that the total estimated cost of the Nordic energy transition is roughly $357 (€318) billion, less than 1% of cumulative GDP over this period — and almost all of the costs will be offset by fuel savings;
2. Interconnection with Europe is key to reaching low carbon and energy targets — for example through trading electricity;
3. Actions at the city or municipal level as well as national government policies are important in driving change;
4. A long term (i.e. several decades) is required to transition to low-carbon energy systems;
5. The particular circumstances of a country or region influence energy transition; for example, the Nordic countries have plentiful fossil fuels, which they can export to pay for domestic decarbonisation. But, as climate change is a global concern, exporting its effects in the form of fossil fuels has no impact on the global problem.

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1. For bioenergy, this is based on the assumption that the GHG emitted during biomass combustion does not need to be included, as it will be compensated by the GHG captured during biomass regrowth.

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Challenges for renewable energy supply in the different countries include the reliance on certain energy systems and market forces. For example, dealing with the variability of wind energy in Denmark; a heavy reliance on biomass and forestry products in Finland; the large diesel-powered fishing fleet in Iceland, as well as reliance on diesel generators in remote communities in Greenland and the Faroe Islands. Norway is heavily invested in oil and hydropower, similarly Sweden is reliant on large hydropower and nuclear sources.

All five countries are also dominated by carbon-intensive means of transport. Transport currently accounts for around 40% of CO_2 emissions from Nordic countries. Measures such as electrifying public transport, therefore, have the potential to help reduce CO_2 emissions. However, electrification of transport is more difficult outside urban settings and the technology is not available for heavy-duty vehicles, such as buses, lorries and aeroplanes.

The cost-effectiveness of changing the energy system is also demonstrated by the IEA data. The total cost of energy transition in the Nordic countries is estimated at $357 billion (€327 approx.), which is less than 1% of total GDP over the period of transition. The researcher suggests almost all of these costs will be offset by fuel and health savings from the reduction of air pollution. The researcher says there is still room for expansion of renewable-energy sources in the Nordic countries and the transition to zero-carbon economies relies on continuing technological advances in renewable technologies and energy efficiency.