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Contestation, contingency, and justice in the Nordic low-carbon energy transition

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ABSTRACT

The five Nordic countries have aggressive climate and energy policies in place and have already emerged to be leaders in renewable energy and energy efficiency. Denmark is renowned for its pioneering use of wind energy, Finland and Sweden bioenergy, Norway hydroelectricity and Iceland geothermal energy. All countries aim to be virtually “fossil free” by 2050. This study explores the Nordic energy transition through the lens of three interconnected research questions: How are they doing it? What challenges exist? And what broader lessons result for energy policy? The study firstly investigates the pathways necessary for these five countries to achieve their low-carbon goals. It argues that a concerted effort must be made to (1) promote decentralized and renewable forms of electricity supply; (2) shift to more sustainable forms of transport; (3) further improve the energy efficiency of residential and commercial buildings; and (4) adopt carbon capture and storage technologies for industry. However, the section that follows emphasizes some of the empirical barriers the Nordic transition must confront, namely political contestation, technological contingency, and social justice and recognition concerns. The study concludes with implications for what such historical progress, and future transition pathways, mean for both energy researchers and energy planners.

1. Introduction

This article explores the history and dynamics of the Nordic low-carbon energy transition. The Nordic region offers a paradigmatic example in the real world where communities, companies, and countries have taken concrete efforts to successfully reduce their greenhouse gas emissions and improve energy security. It has long been promoted within the academic literature as a blueprint for technological innovation and renewable energy deployment (Sovacool et al., 2008; Borup et al., 2008; Sovacool, 2013) as well as the underlying politics and institutional dynamics behind its energy and climate policies (Westholm and Lindahl, 2012; Nilsson et al., 2011) and its promotion of electricity trade and interconnection (Unger and Ekvall, 2003).

Today, the five countries that comprise the Nordic region—Denmark, Finland, Iceland, Norway, and Sweden—have progressive energy and climate policies that are perhaps the most ambitious in the world. Each has a series of longstanding policy goals; each has binding climate targets; each are attempting to become entirely or mostly “fossil fuel free” or “carbon neutral,” with Denmark, Sweden, and Norway committed to 100% renewable energy penetration, Finland 80%, and Iceland 50–75%. Indeed, as the International Energy Agency and Nordic Energy Research (2016) recently noted, electricity generation across the Nordic region is already 87% “carbon-free” and the regional economy has “exhibited a steady decoupling of GDP from energy-related CO_2 emissions and declining CO_2 intensity in energy supply for decades.”

This study explores the Nordic energy transition through the lens of three interconnected research questions: How are they doing it? What challenges exist? And what broader lessons emerge for energy policy? In answering them, the study aims to make three contributions. First, the Nordic experience may indeed offer lessons or a roadmap that other countries can follow. Important factors critical to successful Nordic decarbonization so far include an emphasis on industrial energy efficiency; a shift from fossil fuels to low-carbon forms of heating; expansion of distributed and renewable sources of electricity; and, perhaps most critically, a stable and supportive policy environment involving ambitious carbon taxes and strong incentives coupled with the almost complete displacement of fossil fuel and a moderation of nuclear power (which may not be going away so quickly). Contrary to much conventional wisdom, the Nordic energy transition illustrates that an energy system potentially based on distributed resources,

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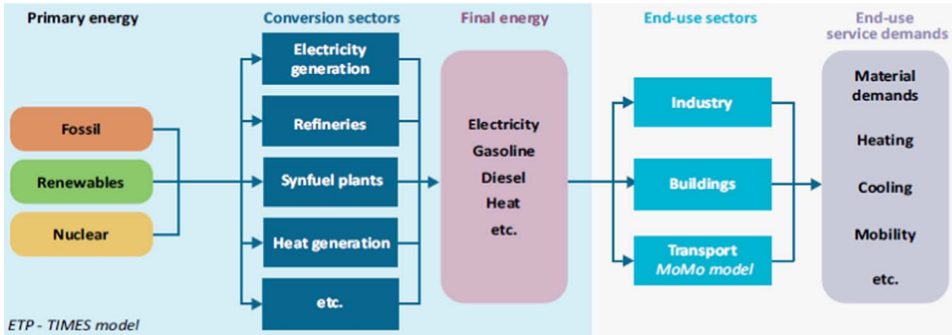

Fig. 1. Structure of the Nordic Energy Technology Perspectives model.
Source: Modified from International Energy Agency and Nordic Energy Research (2016), Nordic Energy Technology Perspectives 2016 (Paris: OECD, 2016). Notes: TIMES=The Integrated MARKAL-EFOM System, MoMo=Mobility Model.

interconnected European grids, and flexibility could be less costly, and deliver greater value through co-benefits, than one reliant entirely on centralized, fossil-fueled sources of energy. These technology and policy lessons could be worth exporting.

The second contribution of the article, however, is to emphasize the contingency and sheer difficulty of low-carbon energy transitions. Even if it all goes to plan—and it may not—the Nordic transition will still take decades until 2050. The Nordic countries must address the need to decarbonize transport as well as power and heat; build interconnectors to incentivize new power capacity; and green both residential buildings as well as large energy and carbon intensive industrial firms. The Nordic region also involves a set of countries that are relatively small in terms of geographic area and population, wealthy in terms of economic development, and socially committed to environmental goals. The Nordic countries sit on clean energy resources that could be exploited beyond the population's needs but suffer from varying degrees of social opposition in some circumstances. The region also remains a large net exporter of oil and gas. The transition, therefore, is contested and contingent, and it will create its own set of winners and losers. While the topic of transitions has become more prominent in the energy studies literature, most work has focused on other areas. Recent dimensions explored include the temporal dynamics or speed at which a transition can take place (Sovacool, 2016) as well as historical trends (Grubler et al., 2016; Smil, 2016; Fouquet, 2016a, 2016b), politics and governance (Kern and Rogge, 2016), and even cost and sectoral dimensions (Sovacool and Geels, 2016). But none have yet looked at how contingency, contestation, and justice can affect decarbonization pathways and create a series of obdurate challenges that can overcome even the best of intentions.

A third and final contribution is both future-orientated and practical. Although it has certainly been ongoing for at least a few decades now, the Nordic energy transition has not yet been completed. Because the Nordic countries have climate and energy targets that span into 2030, 2045, 2050 and beyond, they can still be influenced by stakeholders. This study therefore hopes to both exert influence over Nordic policy as well as temper the optimism inherent in the discourse about the future Nordic energy transition. It does this by underscoring the immensity of the task and raising the salience of perhaps neglected concerns surrounding technology, politics, and social justice. Ultimately, even if the Nordic region has perhaps the most progressive *policies*, it must match these over the coming decades with consistent empirical *performance*.

2. Research methods

The research design and primary data for this study draw heavily from International Energy Agency and Nordic Energy Research (2013) as well as International Energy Agency and Nordic Energy Research (2016). These two reports, both focused on energy and carbon technology pathways in the Nordic region, rely on a broader methodology employed in the International Energy Agency's *Energy Technology Perspectives*. This methodology involves a mix of back-casting and forecasting over different scenarios from the current time (2011 for the first report, 2013 for the second) to 2050. The approach attempts to reveal, through optimization modeling, the most economical ways for the Nordic societies to reach their desired outcome of being fossil-free by 2050. The idea is that by synthesizing different modeling approaches that reflect in-depth insights spread across different sectors, such as electricity or transport, one can get robust and reliable results. The section of the paper "How are they doing it" replicates the scenarios presented by this model, drawn from a mix of publicly available data connected to the two reports as well as enhanced and deepened analysis gleaned from correspondence with two of the report's authors, Benjamin Donald Smith and Markus Wråke.

More specifically, the "Nordic Energy Technology Perspectives" model, or NETP, allows for the integration of data from four sub-models: energy conversion, industry, transport, and buildings (meant to encompass residential and commercial entities). The NETP enables one to explore outcomes and scenarios matched to variables in energy supply (such as the intermittency of some renewable sources of electricity) as well as the dynamics of demand across three sectors (industry, transport, buildings) which are also the largest source of Nordic greenhouse gas emissions. Fig. 1 displays the complex interaction of these various elements and how the NETP treats processes that convert primary energy to final energy utilized across demand-side sectors. As the IEA states, the NETP is a cost optimization-based model designed to enable "a technology-rich, bottom-up analysis" of the Nordic energy system.

While the NETP model is state-of-the-art and still used by the IEA, a few shortcomings exist. As the IEA and Nordic Energy Research (2016) acknowledge, "many subtleties cannot be captured in a cost optimization framework: political preferences, feasible ramp-up rates, capital constraints and public acceptance." So, the model is best considered a useful snapshot or tool, rather than a completely accurate portrayal of reality. In other words, the long-term projections drawn from the NETP contain substantial uncertainties, and many of the assumptions underlying the analysis will change in the future, affecting its accuracy. Moreover, the NETP does not account for some of the secondary costs from climate change, such as investments made in adaptation and resilience. Lastly, although the NETP does account for innovation, technological learning, and reductions in cost among many energy systems, it relies heavily on the state of that technology (and its respective markets) as of 2016. Put another way, the NETP does not presume the appearance of sudden breakthrough technologies, nor does it rely on systems that were not considered commercially available as of 2016. That makes it well suited to study incremental changes, but transformative shifts are harder to fully capture. That said, the NETP does acknowledge Nordic energy and climate policies already imple-