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Towards a low carbon energy future – Renewable energy cooperation between Germany and Norway

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ABSTRACT

Renewable energy is a cornerstone of German climate change policies. Germany has adopted particularly ambitious renewable energy targets, and is now implementing an *Energiewende* – a transition to a nuclear-free and low-carbon energy system. The transition could be eased through European cooperation. This article investigates the economic, political, environmental and technological factors that act as drivers and barriers to renewable energy cooperation between Germany and Norway. The article finds that German actors see Norwegian electricity as a means for enhancing the stability of their electricity system as Germany shifts to a greater reliance on renewables. In Norway the picture is more mixed. Norwegian state-owned electricity producers and grid operators are interested in cooperation largely out of profit motives, but expect Germany to create a favorable environment for investors. Energy-intensive industries and consumers on the other hand, are afraid that more electricity cooperation with Germany will raise electricity prices. The Norwegian environmental movement is split on the issue. Parts of the movement see renewable energy cooperation as an important step towards a European low-carbon energy future. Nature and outdoor organizations, however, argue that new renewable energy infrastructure, including pumped-storage hydropower, will result in major environmental impacts. If cooperation is to be achieved, these economic and environmental concerns will have to be taken seriously.

1. Introduction

Renewable energy is a cornerstone of Norwegian and German climate change policies. Norway is already nearly completely dependent on hydroelectricity and thus, has achieved a low carbon electricity system. Germany is setting out to decarbonize its electricity sector in the next three-and-a-half decades while phasing out nuclear energy. This means there will be a dramatic expansion of renewable energy capacity. As Germany increasingly expands its share of renewable energy, which fluctuates based on the weather, time of day, and seasons, finding ways to balance this electricity and store it for times when renewable energy supply may be insufficient is taking on a new importance.

In 2010, Germany set a goal to obtain 80% of its electricity and 60% of its total energy from renewable sources by 2050. As of the end of 2013, it was obtaining about 25% of its electricity from renewables (compared with only 3% in 1990). The goal of the *Energiewende* – the German term for an energy transition to a nuclear-free and low carbon energy supply – is to maintain a competitive economy while shifting the energy structure from a heavy dependence on fossil fuels and nuclear energy to a system based primarily on renewable energies. Achieving this goal will be a herculean task, but one that could be eased through cooperation with European neighbors [1]. The *Energiewende* will require the development of much additional renewable energy capacity. While technically this could be done completely domestically, from a German perspective there are cost, efficiency, nature conservation, and stability reasons, to pursue a more integrated system with European neighbors. This makes Norwegian hydro dams, a potential form of electricity storage, of considerable interest to Germany.

The goal of this article is to better understand the potential for expanded renewable energy cooperation between Germany and Norway, with a special view to pumped-storage hydropower and new electricity grid inter-connectors. The article finds that there are numerous factors that speak for cooperation on renewable energy development between Germany and Norway but also many economic and environmental concerns that act as barriers to such cooperation. Future cooperation will be dependent on whether the concerns of potential opponents can be adequately overcome.

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2. Methodology

This article followed an inductive logic, seeking to identify what key stakeholders and experts see as the main forces speaking for and those blocking renewable electricity cooperation between Germany and Norway across the North Sea. Twenty-one non-standardized interviews were conducted with 10 experts and decision makers in Germany and 11 in Norway (see Appendix for a full list of interviewees). German interviewees included experts working in the Ministry of the Environment, the Federal Maritime and Hydrographic Agency, the Federal Association for Renewable Energy, the expert commission monitoring the German energy transition, a former EU Commissioner and member of the German Green Party, a member of the Diet from the Christian Democratic Union, renewable energy think tanks and associations, and an expert consultant. The Norwegian interviewees represented six of the seven parties in the Norwegian Parliament (The Liberal Party chose not to participate) and key stakeholders in the field of renewable energy (hydropower producers and non-governmental organizations).

The interviewees were asked about their views on German-Norwegian electricity cooperation and the possibilities of winning public acceptance of pumped hydro storage facilities and related infrastructure. In addition, the authors participated in conferences, hearings, and events focused on the *Energiewende* and German-Norwegian renewable energy cooperation. Official documents, such as governmental white papers, reports by non-governmental organizations, research reports and presentations by governmental officials and stakeholders were also consulted.

3. Regional cooperation in electricity exchange

The decision of whether to strengthen international electricity interconnectivity is dependent on a variety of factors. Certainly enhancing domestic energy security is a major reason why countries agree to electricity trade. Electricity shortfalls may be prevented or minimized through international electricity exchanges. Essentially, having more international grid interconnectivity can strengthen the resilience of an electricity system. There may also be economic reasons to cooperate in electricity production and distribution. With a larger market, electricity producers have a larger range of potential customers and consumers may be able to access cheaper sources of electricity. If, however, large amounts of new infrastructure are necessary to make electricity exchange possible or if there are substantial technological challenges involved, greater interconnectivity could drive up electricity costs, at least in the short run.

From an environmental perspective, greater regional electricity cooperation could bring various benefits. It could make possible greater access to renewable energies and bring about system efficiencies that would reduce the amount of electricity infrastructure needed when compared with completely independent systems. Yet, at the same time, if large amounts of new infrastructure are necessary to make such cooperation possible, there could be substantial degradation to natural areas and other negative environmental consequences. Cooperation will thus be dependent on whether the countries involved assess that the overall potential benefits outweigh the potential costs. This in turn will depend on the strength of the actors supporting and opposing cooperation. Public acceptance of new renewable energy infrastructure and added costs could be a decisive factor in any final decision.

4. Balancing the intermittency of renewables with pumped-storage hydroelectricity

Systems with large amounts of fluctuating renewable electricity (wind and solar power) can suffer from intermittency problems. One way of enhancing stability is through greater regional interconnectivity. Another is with the use of electricity storage systems. There are various types of energy storage systems, including batteries, hydrogen, methane, and compressed air. In general, energy storage systems are expensive and not very efficient [2]. The most widely used electricity storage system globally is pumped-storage hydropower. By pumping water from a lower elevation to a reservoir at a higher elevation using electricity produced from wind or solar power facilities, this low-carbon electricity can be “stored” as potential energy in the form of water for later use. At times of low wind or sun when supply from renewables is insufficient to meet demand, water can be released from the dam to produce electricity. Even though considerable energy is lost when energy is stored or converted in this way, it may still be more efficient to make use of pumped-storage hydroelectric facilities than it is to simply turn off wind turbines when more energy is produced than can be transported through the grid or consumed.

The capacity for pumped storage is limited in Germany for topographical reasons. As Norway has a large number of dams that it uses for its own electricity production there is considerable potential for pumped hydro storage. According to one estimate, Norway could technically contribute 20,000 megawatts (MW) of pumped hydro storage capacity [3].

5. Germany’s *Energiewende*

The German push to expand renewable energy began in 1991 with a renewable electricity feed-in-law and gained a substantial boost with the passage of the Renewable Energy Law in 2000 as shown in Fig. 1. It was also in 2000 that the first decision to phase out nuclear energy was reached under the coalition government between the Social Democratic Party and the Green Party.

In September 2010, the federal government in Germany presented an energy strategy (*Energiekonzept*) that aims at a far-reaching transformation of the energy supply. By 2020, CO_2 emissions are to be reduced by 40% compared to 1990 levels, 55% by 2030 and 80–95% by 2050 [4]. As of the end of 2011, the emissions were down by about 27% compared to 1990 levels [5]. These climate change goals are, together with energy security and competiveness concerns, major reasons behind the push to further expand renewable electricity and improve energy efficiency [6].

When the 2010 energy strategy was presented by the conservative ruling coalition of the Christian Democratic Union/Christian Socialist Union (CDU/CSU) and the Free Democratic Party, it was coupled with the argument that nuclear energy would be necessary

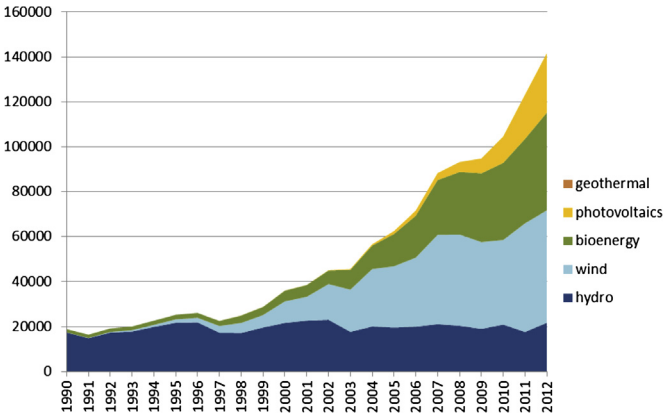

Fig. 1. Electricity generation from renewable energy sources in Germany (GWh). Reprinted with permission from the Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit, Berlin.