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Aiming to be Environmental Leaders, but Struggling to go Forward: Sweden and Norway on Energy System Transformation

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Abstract

To achieve the needed 95% reduction in greenhouse gas emissions, almost all energy consumed globally will have to stem from low-carbon sources, not least from renewable energy. Sweden and Norway have long sought to become world environmental leaders, institutionalizing policies on environmental and climate issues as well as taking ambitious positions in the global climate negotiations. They are comparably well placed to become carbon-neutral societies, with large renewable energy resources and substantial financial and institutional capacity to invest in reaching this target. Focusing on the production of new renewable energy in their energy system transformations from 1960 until the present, this paper investigates why the two countries have pursued such different paths, and what might be learned. The method used is the 'most similar systems design'; data sources are public documents and 16 interviews with key persons in Sweden and Norway. The results show that politics and public policies have had profound impacts on which renewable energy sources have been developed, when and how. Sweden, lacking access to new cheap hydropower after 1970, has generally implemented more ambitious and comprehensive policies, leading to much higher production of new renewable energy than in Norway. Differences might thus be explained by differences in resource endowments, long-term research and innovation efforts, combined with creation of markets and predictable policies. Enhanced new renewables production has boosted energy security and stabilized the energy systems in both countries. The Swedish-Norwegian green certificate market has mainly contributed to expansion of already cost-competitive or nearly cost-competitive technologies: small-scale hydropower in Norway and biopower and wind power in Sweden.

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Keywords: renewable energy; energy policy; transformation; comparative study; historical institutionalism; Sweden; Norway.

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1. Introduction

More than two thirds of the world's emissions of greenhouse gases stem from production and consumption of various types of energy [1]. Thus, large-scale world-wide energy system transformation is essential for reducing greenhouse gas emissions to sustainable levels. Moreover, energy policy is one of the most thoroughly regulated areas in nation-states, and the state is the only authority with the legitimate means for changing the major patterns of energy production and consumption for its citizens. Therefore, national efforts at long-term large-scale transformation aimed at increasing national production and consumption of renewable energy, together with energy efficiency measures, are crucial. In other words, most countries need their own versions of the German *Energiewende*. Such transformation may not only be economically beneficial in terms of lower costs of energy and creation of new industries, but will also lead to improved energy security and better living environments [e.g. 2].

Despite numerous similarities, Sweden and Norway have developed very different energy systems over the past 50 years, not the least capacity for production from *new renewable energy sources*.[†] In the 20th century, Norway expanded production of its traditional source of electricity, hydropower, extensively, making it the largest hydropower producer in Europe. Sweden produces more renewable energy, in both absolute and relative terms, than Norway from all the other renewable power sources that are beyond the prototype stage in technological development [e.g. 3][‡]. This paper undertakes a historical comparative analysis of renewable energy policies from 1960 until the present to shed light on renewables policies in relation to energy system transformation. Both countries have achieved comparably large shares of renewable energy, with Sweden having more than 50% of energy domestically consumed from renewable energy and Norway about 64%. Now both seem to be struggling to transform their energy systems further, for example through decarbonizing the transport sectors, not least because future changes are expected to cost more than previous ones. The research question is:

What might explain the large differences between the production of new renewable energy in Sweden and Norway, and what can we learn from this?

2. Theory background

The theory of historical institutionalism offers a relevant framework, for several reasons. First, it enables identification of *critical junctures.* Here comparative studies have the advantage that they may show how, for example, that some factors were decisive in one country and not the other for crucial decisions in energy policy [4]. Second, energy policy is a thoroughly regulated field in most countries, often involving decisions on investment with very long time horizons. Therefore, the institutional setting, in terms of both formal organizations and the informal rules under which they are created, is likely to be decisive [e.g. 5].

As both Sweden and Norway have needed to expand their production of energy to cover increasing needs, including for electricity, it is natural to expect them to go for the 'low-hanging fruits' first. This means initially prioritizing the expansion of hydropower production, where the costs of production were very low and the resource potentials large. When this was no longer an option, we would expect them to use other types of viable energy where they have other sizable resource potentials, as with bioenergy. This leads to expectation 1:

> Physical resource potentials as well as the maturity of technologies influence the pace in expanding production from new renewables technologies.

In the international literature on energy policy, crises in energy supply, fluctuating prices and nuclear accidents are typical external factors that strongly influence national energy policies [e.g. 6]. Such factors might lead countries to pursue policies more in line with the aims of creating an environmentally-friendly state and escaping 'carbon lock-in' [e.g. 7], such as investing in renewable energy production and consumption. This leads to expectation 2:

[†] 'New renewable energy sources' are all renewable energy sources apart from large-scale hydropower. Traditional bioenergy in the form of wood is not included in this term, as this is not a new source of energy.

[‡] Please contact the author if you have questions about the references. Several could not be included in the text.

> External shocks, such as crises in energy supply, nuclear accidents and major fluctuations in petroleum and other energy prices have had decisive effects on Swedish and Norwegian policies, making politicians and polities aware of the risks associated with current policies and giving them incentives to promote production from new renewable sources.

As the EU has wanted to be a world environmental leader, and has increasingly put more emphasis on climate-related issues such as expansion of renewable energy [e.g. 8, 9], it is to be expected that Sweden, as an EU member, will be more influenced by the EU than non-member Norway in the sphere of climate and energy policy. This leads to expectation 3:

> Membership in international organizations (here: the EU) has influenced levels of ambitiousness in renewable energy policy in EU-Sweden, but not to the same extent in EEA-Norway.

3. Method

The method of 'most similar systems design' will be employed. This method is used to compare cases that ideally are similar on all variables except for one, and have different outcomes on the dependent variable [10]. All similar independent variables can therefore be eliminated except for the one or the few where the cases differ. These remaining variable(s) are therefore expected to explain the outcome on the dependent variable [11]. Eliminating irrelevant variables is thus used as a strategy to enable a more focused analysis. This study is based on a wide range of sources, including 16 semi-structured interviews with key respondents in Sweden and in Norway (see Appendix). In order to get comparable interviews as regards organizations, respondents were selected fairly symmetrically from Sweden and Norway so that the ministries in charge, regulating bodies, umbrella interest organizations of energy producers, and interest organizations of wind and bioenergy would all be represented.

4. Similarities between Sweden and Norway

From a macro-perspective, Sweden and Norway are about as similar as is possible according to standards of comparative country research. First, their governments have similar official political aims in policies that typically stimulate growth in renewables – high climate ambitions [e.g. 12-14], boosting energy security through increased domestic production of renewable energy, and being world leaders in innovation and entrepreneurship [e.g. 15, 16]. Second, to expand renewables production on a large scale, an ample resource base is needed. Both countries are well endowed with renewable energy sources, with large potentials for hydropower, wind power and biomass power [e.g. 17-22]. Third, their electricity supply systems share several features, including the role of the former monopolists Vattenfall and Statkraft.

Fourth, renewable energy production in both Sweden and Norway is subject to the influence of EU energy policies, in particular through the EU Renewable Energy Directive (Directive 2009/28 EC, the Renewables Directive). On 1st January 2012, Norway and Sweden launched a common certificate market in order to achieve the national renewables targets stated in the Renewables Directive, which requires Sweden to enhance its share of domestically consumed renewable energy from 39.8% in 2005 to 49% by 2020, while Norway must increase it from 58.2% in 2005 to 67.5% by 2020 [23-26]. Within 2020, the two countries are to add on a total of 26.4 TWh of electricity from renewable sources together. The price for this increase will be paid equally by the consumers. New renewables projects will thus be located where it pays off the most to invest, regardless of country [25, 26].

5. Analysis: What might explain the large differences between energy systems in Sweden and in Norway, and what can we learn?[§]

The analysis shows that the Swedish and Norwegian governments clearly have kept resource potentials in mind when deciding on policies to promote bioenergy (Sweden), and electrify the country and also use electricity for heating (Norway). For Norway, electricity from hydropower was a potentially very large and abundant source. Still, it was not clear that this would be the single dominant source of electric power in the early 1970s. It was only when popular protests made nuclear energy extremely contentious, analyses showed potentials for further expansion of hydro power and after the Three Mile Island accident that the government decided to not allow construction of nuclear reactors in Norway. Sweden's sizeable development of bioenergy has come about as a result of various factors over several decades, including sustained R&D efforts, creation of markets through fossil fuel taxation, and constructing extensive district heating systems. In Norway, having access to abundant and cheap hydroelectric power has made other renewable energy sources relatively expensive in comparison. Thus, without extra support mechanisms and other types of stimulating measures, such energy production has not been enhanced. The need for such 'pull-factors' to expand production from new renewable sources has been pointed out by Gross et al. [27].

Both Sweden and Norway have set aside significant resources for research on renewable energy. However, the Swedish authorities, lacking the same access to new cheap hydropower, have seemingly launched far more wide-reaching, extensive and long-lasting support programmes for various types of renewable energy. These 'pull-factors' have ultimately also contributed to much greater penetration of new renewables sources than in Norway, particularly in the case for bioenergy. With technology expansion, this up-scaling has pressed down the prices for installation and other parts of the supply chains, bringing lower costs as regards, for example, wind energy than in Norway. Thus, energy system transformation may require a host of different types of regulatory measures as well as various support mechanisms and expansion of relevant infrastructure such as electricity grids.

What at any moment is costly or less costly in a market will depend on several circumstances. For example with steep projected cost digression curves for photovoltaic energy technology [28], Norwegians might in the future choose to install integrated solar systems when solar rooftops become commercially viable and cheap, although this option might seem unrealistic today. Interview data also show another factor that might be decisive for investment is *regulatory stability*, giving investors the safety and motivation to invest in renewables projects. Otherwise, many investors will probably not take the risks involved in investing in new renewable energy projects. Sweden seems to have had larger regulatory stability in its renewables policies from the 2000s onwards, while changing policies, particularly as regards wind power support, has made Norwegian investors sceptical.

The analysis also gives support to expectation number 2. The oil crises of 1973 and -79 can be viewed as typical external shocks. They influenced Norwegian and Swedish energy policies in the 1970s, leading to more research on alternative energy sources such as various types of renewable energy and other measures to enhance energy security. In Sweden, this was also a major motivation to stimulate long-term programmes to promote bioenergy, while in Norway it motivated the promotion of large-scale substitution from oil-fuelled heating systems to electric heating. Nuclear accidents around the world can also be classified as external shocks.

The Three Mile Island accident of 1979 seems to have contributed to the final decision never to build nuclear power in Norway, and was the *prima facie* reason for the Swedish government's decision to hold a referendum on the use of nuclear power in 1980. The 1986 Chernobyl accident greatly increased Swedish nuclear resentment and motivation for alternative sources of electricity. Later events that may be perceived as 'crises' – the periods of high electricity prices in 1997 and 2001 in Norway – stimulated the establishment of energy-efficiency programmes, improved cross-border electricity trade and investment in developing alternative means of energy supply. These periods were thus important for the Norwegian government's motivation to establish Enova, which promoted alternative energy sources, including wind power and heat pumps. Such crises opened windows of opportunity for politicians and other political engineers who had wanted to change the energy systems, providing legitimacy to introduce targeted support mechanisms for renewable energy. The Fukushima accident, however, seems to have had little impact in Sweden and in Norway, in contradiction to several other European countries.

[§] Only the analysis is included in this paper, due to the Energy Procedia length restrictions. Please contact the author if you have questions about the data that the analysis is based upon.

Internationally, a major driving force of renewable energy is seemingly creation of domestic industries that provide workplaces. However, with very low rates of unemployment in Norway in recent decades, this argument has not carried much weight for Norwegian decision makers. When oil and gas prices were falling and it seemed that the oil reservoirs in the North Sea would soon be depleted, greater attention was paid to offshore wind in particular as a source of industrial opportunities. However, discoveries of new petroleum fields led to less attention and investment in offshore wind [29]. In Sweden, the job market argument has been used by policy makers several times, for example in the decisions to stimulate increased use of bioenergy in the 1980s and onwards.

Still, crises are not the only factors that have been decisive for changes in national energy policies. Various measures have been crucially influenced by the political decision makers in government, as when Norwegian Prime Minister Jens Stoltenberg (and his government) abandoned plans for green certificate schemes with Sweden in 2005, and his decision that no major new river systems should be dammed up for hydropower production. National energy policies are thus inherently *political* in nature, and energy-related crises can provide national decision makers with a window of opportunity to choose different paths, including 'greener' ones.

The interview data also give some support to our expectation no. 3. Some respondents mentioned that the EU had made Sweden's climate and energy policies more ambitious in general. Norway, as an EEA member, is also affected by EU policies in this field, as shown when Norway implemented its first support mechanism for renewable energy when the EU Renewables Directive had to be implemented. Still, unsurprisingly, EU influence on Sweden as regards renewables appears to have been greater than in the case of Norwegian renewables policies, and has probably made Swedish energy policies somewhat more ambitious. On the other hand, Sweden has had national targets that were higher than those outlined in, for example, the EU Renewables Directive and that have already been achieved and even exceeded. The data also show that Sweden's more rapid expansion in new renewable energies has been caused by broader sets of implemented measures, including higher support rates, more regulatory certainty and more consistent political signals over time, than in Norway, particularly the last decade.

6. Conclusions

The analysis supports all three presented hypotheses. First, governments have historically taken domestic resource endowments and technological maturity into consideration when developing national energy system. For example, when strongly needing more energy from the 1960s onwards, the Norwegian governments supported building out hydropower. The Swedish mainly opted for bioenergy when they could no longer build out their hydro resources.

Second, international energy crisis have impacted the politics and policies in both countries. The analysis identifies four crises that have impacted on political will and then policies to stimulate renewables developments in Sweden and in Norway; The oil crises of the 1970s led especially to increased efforts in research and development, but also to programmes for fuel switching in Sweden. The 1979 Three Miles Island accident impacted on the final Norwegian governmental decision to stay away from nuclear power, while there was a referendum in Sweden in 1980 due to the further increased controversy. Moreover, the Chernobyl accident of 1986 motivated further political support for bioenergy policies in Sweden. Finally the 'electricity crises' in 1997 and 2001 and the popular protest against the unstable and high electricity prices gave Norwegian policy makers the motivation to establish Enova, the first public Norwegian body to give support to renewable energy production.

Third, the analysis shows that the EU membership has contributed somewhat to making Sweden more ambitious in its policies on renewable energy than non-member Norway.

We cannot know what the demand for energy will look like in the future. Rapid technological change might put especially Norway at a disadvantage, as so much of the economy is linked to its petroleum sector, which might be perceived as a typical energy system lock-in. The petroleum industry also possesses considerable structural power to influence decision making in its own interests, possibly obstructing a shift to a more sustainable society.

Take the internet revolution: a technological breakthrough previously unimaginable. Yergin [30] comments:

> There is no question that we are at a turning point in world energy. But then we are often at a turning point. Just as everybody gets comfortable with what they expect to happen, a big change comes along that undercuts existing assumptions.

Many changes in energy systems will probably not come about without stimulation of various kinds, as noted by several analysts and business representatives. While we may hope for the best in terms of technological changes, the paper has shown that changes in this heavily regulated field have often come about through government interventions. Exactly how Norway and Sweden should change their energy systems is not obvious, as there are numerous pathways to sustainable energy systems. One thing seems clear: in order to increase renewable energy production and consumption, general measures to stimulate research, in combination with the creation of commercial domestic markets to bridge the technological 'valley of death', and long-term regulatory stability, will remain essential. Only comprehensive measures will lead to the needed energy system transformation.

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Appendix: List of respondents

Andersson, Kjell. Svebio, Sweden
Astrup, Nikolai. Høyre (Norwegian conservative party), Norway
Borgström, Truls. Näringsdepartementet (Ministry of Enterprise, Energy and Communications), Sweden
Ebenå, Gustav. Energimyndigheten (Swedish Energy Agency), Sweden
Flatby, Rune. Norges vassdrags- og energidirektorat (NVE) (Norwegian Energy Resources and Water Directorate), Norway
Fredriksson, Gunnar. Svensk Energi (Swedish Energy), Sweden
Hegg Gundersen, Mari. Norges vassdrags- og energidirektorat (NVE) (Norwegian Energy Resources and Water Directorate), Norway
Hersvik, Rune. Norsk vind (Norwegian Wind), Norway
Hjørnegård, Sigrid. Energi Norge (Energy Norway), Norway
Holm, Marius. Zero, Norway
Isachsen, Øyvind. Norwea, Norway
Johansen, Øivind. Olje og energidepartementet (OED) (Norwegian Ministry of Petroleum and Energy), Norway
Kåberger, Thomas. Chalmers University; former CEO in Energimyndigheten (Swedish Energy Agency), Sweden
Leistad, Øyvind. Enova, Norway
Olesen, Johanna. Svensk vindenergi (Swedish Wind Energy), Sweden
Pedersen, Carl-Arne. Svensk vindenergi (Swedish Wind Energy), Sweden