Nordic stakeholder views on how to develop the energy system by 2030[1]

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1. Abstract

The Nordic states pursue ambitious energy transition goals both through national energy policies and in the framework of Nordic cooperation and wider multilateral fora. Achieving these goals necessitates the involvement of key stakeholders from the public, private and nongovernmental sectors as regulators, innovators and as advocates of relevant policies and solutions representing a multitude of involved interests.

Exploring these interests, we found three distinct views of which the first two views enjoy strong inter-Nordic support. View 1 prioritizes market and grid development, View 2 focuses on electric transport as well as solar and wind power. View 3, the “Finnish” view, focuses on security of supply and prioritizes biofuels over electric transport. The common ground among the views points to the need to further strengthen stakeholder interaction and policy coordination in order to enhance cooperation. Our analysis is based on Q-methodological experiments where 43 expert stakeholders (see Table 3) sort statements concerning their preferred policies and solutions regarding the development of the electric energy system. We identify these three subjective views through factor analysis which also produces statements indicating common ground.

2. Problem

The energy transition targets of the Nordic states are ambitious. They jointly claim to seek a 100% decarbonisation of their energy systems by 2050 (Nordic Energy Research and IEA, 2013, p.8) while each of the Nordic states also has national renewable energy and GHG emission reduction targets (Table 1, see Appendix). These targets are political targets as they represent a negotiated percentage that is to be achieved through combining policy measures and instruments, some of which have not yet been adopted. At the same time, the Nordic states have both technical and R&D co-operation on energy issues, a joint electricity market, NordPool, and reciprocal energy trade, while several recent reports call for enhanced co-operation, noting the existing interdependencies among the Nordic energy systems and the benefits of co-operation for reaching the commonly agreed targets (e.g. Karimi et al. 2018; Ollila 2017).

Our focus is on the policy challenge of which measures to combine in the Nordic area so that the transition target will be met. Crucially, from the technological and infrastructural point of view, several combinations of measures are possible. However, they need to become accepted by the key stakeholders to be realistically adopted, promoted and implemented. We therefore examine stakeholders’ preferred policy measures to ascertain which combinations best serve to enhance Nordic co-operation. The focus is on the energy system as a whole due to the interdependence of production, distribution and consumption. As a result, uncertainty, complexity and cross-sectoral linkages affect energy policy-making.

We examine the subjective views of public authorities, energy companies and NGOs in the

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Nordic states and the clustering of opinion among them. Connecting the subjective views of key stakeholders with a range of policy choices and technological solutions also makes it possible to deal with the uncertainty of energy transitions (Sovacool, 2017) without simplifying it to a question of politics, economics or technology. Additionally, a Nordic focus helps to advance regional co-operation that for its part is one of the strategies recognised on the EU level for furthering energy transition.

We ask two questions:

1) In the subjective views of Nordic key stakeholders, which solutions to develop a more climate-neutral and resource-efficient energy system by 2030 should be preferred?
2) Is there evidence of any clustering in the views of Nordic key stakeholders along stakeholder groups or along national lines that might influence the prospects of the intended transition, including prospects of Nordic cooperation to that end?

3. Study Design

Building on previous work focusing on Finnish stakeholders (Toivanen et al. 2017), this study extends the geographical focus to stakeholders from Norway, Sweden, Denmark and Finland. Finnish stakeholders are purposefully overrepresented due to the immense transition challenges Finland is facing in being a highly energy-intensive country compared to these three other Nordic countries (ibid., 151). In particular, energy consumption in the industrial sector is very high in Finland. At the same time, Finland's 2030 energy strategy acknowledges some well-known paths of energy transition and sets out a more holistic view of developing the energy system by emphasising flexibility, smart networks, cleaner transport as well as the roles played by energy consumers and citizens in developing the energy system (Valtioneuvosto, 2016). Hence the extra attention to Finland is justified owing to this turning point which the country's energy policies have reached.

We use Q methodology to analyse the subjective views of stakeholders. Analysing stakeholders' views supports the development of policies that make sense to affected stakeholders and thus have the potential to gain acceptance. Q methodology allows stakeholders to share how they view, compare and prioritise a set of policy measures in relation to one another and also enables a systematic comparison of stakeholder views (Robbins & Krueger, 2000).

The starting point is a survey of existing studies, scenarios, reports and policy documents which are then arranged into a structured sample of statements with the help of a theoretical model on the development of the energy system (Table 2). The first dimension of the model deals with stakeholder interests in developing the electric energy system along with issues of resource efficiency, climate neutrality and further interests such as competition, R&D and capacity building as well as energy business. The second dimension covers the production, network and consumption components of the electric energy system. The initial sample of 425 statements was edited into a final sample of 48 statements equally representing each cell of the theoretical model.

The set of statements is then given to a group of stakeholders in a face-to-face setting, where these stakeholders interact with the statements and rank-order them onto a predefined sorting grid (Figure 1). This sorting is followed by an interview enabling the respondents to reflect on the statement set as a whole, on the way they sorted the statements and on any further topics. The Q-sorts in Finland were conducted in spring-summer 2015 (n=25) and the Q-sorts in Denmark, Norway and Sweden were conducted during January and February 2017 (n=18). The completed Q-sorts are then factor analysed to identify similarities between Q-sorts. The analysis resulted in a three factors solution (see Table 3), implying three divergent viewpoints. Each viewpoint is defined by a set of statements with which the respondents in 'belonging' to the factor are broadly in agreement. In this way the factors form coherent attitudinal groups regarding how to develop the energy system by 2030.

4. Results

4.1 View 1: Market and grid development

Central to View 1 is the role competition plays in developing the energy system with a special focus on market issues and the need to develop grid solutions to ensure a functioning market. Support for this view is wide-spread – respondents defining this factor come from all Nordic countries and represent all sectors.

The pivotal role of the market is connected to a variety of other issues related to developing the energy system, such as flexibility of demand, pricing and the polluter pays principle. In addition, the market-based approach is linked to providing wider economic benefits ensuring a cost-efficient energy system. This market focus is significant, as respondents defining View 1 come from each Nordic country and from different sectors, thus confirming broad support for existing NordPool co-operation. At the same time, the energy transitions literature highlights that market-based solutions require not just economic incentives but also ambitious policies (Mundaca & Markandya, 2016; Moe, 2015, p.236).

The second theme in View 1 relates to grid development, especially eliminating bottlenecks. This is in line with both the position of the Nordic transmission system operators (TSO) (Stattnet et al. 2016, p. 44f.) and the existing research on the importance of grid infrastructure development for market entry and competitiveness of renewable energy sources (Mundaca, Dalhammar & Harnesk, 2013; Tenggren et al. 2016). Respondents were sceptical about the role of microgrids in this development. Microgrids were associated with strong individual interests (4Swe[2]), a focus on national-level solutions (13Dk) while for some, they were viewed as supporting the interconnected system in the socioeconomically most efficient way (8Dk). As of 2019, microgrids are not part of national strategies even though they have the potential to enhance the use of local renewable resources, offer resource efficiency gains and can increase the flexibility of the energy system by managing network congestion and optimizing the supply portfolio (Järventausta, Peltonen, Uski, Valta & Aalto, 2020).

4.2 View 2: Smart transport solutions and resource questions

Participants from Denmark, Norway and Finland representing all sectors define View 2. Themes at the centre of View 2 are questions of electric mobility and smart transport solutions as well as resource related questions.

Support for electric mobility, including smart transport solutions, is guided by interests in resource and energy efficiency alongside climate neutrality. Respondents preferred electric vehicles to vehicles using biofuels emphasising how the climate neutrality of biofuels has been questioned. Although the focus has shifted to using advanced biofuels (Soundarajan & Thomson 2013; 15 Nor, 17 Nor), concerns over resource efficiency relate to the whole cycle of harvesting, production and distribution as well as the carbon sink effects of wood-based cellulosic biomass. This view connects support for electric vehicles with the transformation of the electric energy system. Respondents argued that the electrification of the transport sector is vital in ensuring that renewables cover as large a share of energy needs as possible (9 Dk, 11 Dk).

Concerning resource questions, respondents prefer solar and wind (including offshore wind solutions), emphasising the need to develop grids and interconnectors accordingly. Support for offsetting the variable nature of wind and solar is seen in the possibility of electric transport offering balancing functions through vehicle batteries. Respondents also supported early phase-out of nuclear power in favour of solar and wind energy, take a critical view of natural gas as a transition fuel, reject subsidies for existing fossil fuel plants and note sustainability concerns regarding forest-based biomass.

4.3 View 3: Security of supply, biofuels and central role of society

Seven respondents, all based in Finland, define View 3. These participants represent interest groups, NGOs and government offices. The main themes in this view are security of supply, biofuels and the involvement of society.

Questions of security of supply are at the core of View 3. The multidimensionality of the security of supply question is also reflected in the views of the stakeholders. Respondents highlighted self-sufficiency in energy production and the aim for net exports of electricity. In addition, respondents

[2] See Table 3 for respondent information.

made the connection between an uninterrupted energy supply and the role that 'energy islands' or microgrids could play for this end alongside the network operators' ability, if so allowed, to use energy storages as part of grid operations. Concerns over security of supply are also reflected in the support given to nuclear energy by respondents in this view. Security of supply is seen to be in line with the goals of Finland's energy strategy – thus fossil fuel plants should not be supported in the same way as renewable and low-carbon energy.

Support for biofuels is the second theme for View 3. This support reflects the role of biofuels and the biofuel industry in Finland and shows the multifaceted nature of the biofuel debate in relation to energy transitions. Focusing on biofuel vehicles, respondents highlighted the flexibility of using biofuels and the difficulties inherent in the development of a charging station network for electric vehicles. Potential scaling problems of biofuels and the need to consider best use cases for liquid biofuels and biogas in the transport system were nevertheless emphasised by these respondents. Additionally, indirect support was given to the energy use of wood, as measures reducing particle emissions from wood-based heating were not prioritised by respondents.

The final theme in View 3 is the role of society in developing the electric energy system. Respondents connected this to the information needs of citizens that have to be met when choosing an energy solution. In addition, supporting the wider economy, national competitiveness and the well-being and purchasing power of consumers connects to the need to keep energy prices at a reasonable level. This focus on reasonable energy prices is also reflective of Finland's energy intensive industry.

4.4 Common ground as basis of policy development

The three views highlight different combinations of policy options and technical solutions underpinned by different interests. At the same time, our data also points to a set of ideas common to all participating stakeholders. It is important to highlight these statements as they could serve as points of departure for further policy development and cooperation in the Nordic countries.

Promoting flexible smart grids as part of efforts to improve the efficiency of the system is the first area of agreement among the participants. The Nordic TSOs have called for differences and common goals for grid development in the region to be clarified (Statnett et al. 2016, p.6) and there have been calls for more political guidance on co-operation and suggestions of a possible merger (Ollila 2017, p.33). Our study shows that grid development finds support not only in all countries covered but also across all different stakeholder groups, highlighting that extensive co-operation including a diverse set of stakeholders is likely to find support.

A second point of agreement relates to geo-thermal heat pumps. Here, the efficiency benefits are seen to outweigh the side-effects such as reduced demand for services provided by the existing district heating network. The impact of the consumer's choice for a heat pump, which does not contribute much to the maintenance of centralized infrastructure, has to be included in the planning of grid development.

A third point of agreement relates to the connection between ensuring security of supply and underground cabling in here that underground cabling is not seen as the only solution against disruptions to supplies caused by storms or heavy snowfall. Nordic respondents highlighted the need to carefully analyse the costs and benefits of any solution aimed at ensuring security of supply. This stands in contrast to the Finnish electricity market legislation and its push to invest in underground cabling as a reaction to supply disruptions.

A fourth line of agreement is supporting the flexibility of the system through the aggregation of small-scale production of prosumers by means of enabling tariffs and electricity taxes. Here, a possibility is seen to activate and involve consumers with some respondents preferring incentives over penalties.

Additionally, statements on minimum binding requirements for industrial electric motors and data and communication networks as well as on the allocation of R&D funds have been placed in the ‘neutral’ area of the sorting tool of the statements. This indicates a neutral stance on these issues and points to little potential for conflict on these. Still, this neutral stance can also be connected to possible difficulties when it comes to establishing new funding mechanisms and securing new investments. There is a need to develop a Nordic approach to funding research and development in order to maximise the impact of national financial resources, to increase clean energy investments and to encourage private investment as well (Ollila 2017, 23). The need to develop effective funding mechanisms has been taken up by a variety of fora, such as the Clean Energy Ministerial, which highlights investment and finance as one of its core initiatives (CEM 2019).

Lastly, the transport sector is seen as central to the energy transition, although there is no consensus among the Nordic countries on a preference for biofuels or electric vehicles. Norway has introduced incentives supporting electric transport including exemptions from tax and toll road charges, bus lane parking, free parking and reduced ferry rates which were valued by EV owners at about 1900€ per year in 2014 (Figenbaum, 2017, pp.14-15). At the same time, vested interests and industry influence have been identified as impeding the transition to electric vehicles (Kotilainen et al. 2019). By contrast, Finland’s 2030 energy strategy foresees a 30% share of biofuels reflecting the strong forestry industry (Valtioneuvosto 2016). Our respondents stressed the need for continuous exchange with other stakeholders to avoid overlapping infrastructures that fail to optimally facilitate cross-border movement. However, no wide enough forum for this kind of policy cooperation currently exists.

5. Conclusion

We identified three divergent views concerning the development of the energy system by 2030 in the Nordic countries. These three views also focus on different aspects of the energy system. View 1 is in line with the focus of the current TSO level co-operation on technical-infrastructural grid issues in market development. View 2 focuses more strongly on the consumption sector by linking it to network and system management as well as changing forms of production. View 3 then highlights Finnish concerns related to dependence on imports and directs attention to the increasing use of forestry resources in the production of biofuels and the effects of consumption and prosumption in a system that has so far been largely centralized and focused on production.

Regarding our second research question on a possible clustering of stakeholders according to interests, groups or national lines, we found the role of biofuels versus EVs in the energy transition to emerge as a policy issue. Finnish vested interests in the forestry sector and biofuels are important here. Also, the Finnish concern with security of supply stood out. Nevertheless, some Finnish respondents also concurred with the other two Views and those agreeing with the somewhat distinct View 3 do nevertheless share the common statements reported above with the other stakeholders. These statements highlight common approaches to grid development, the inclination to integrate new solutions such as geothermal heat pumps, to test alternatives to underground cabling and to integrate small-scale renewable production in order to support more flexibility in the electric energy system. Work on these issues can offer some starting points for Nordic cooperation that would enjoy wide-ranging stakeholder support.

Recommendations:

- Engaging a wide stakeholder base for the development of the energy system and energy policy in the Nordics is needed alongside the more technical cooperation engaged in so far. This may require a joint regulatory, business and policy forum for discussing and developing new solutions in order to avoid parallel but unconnected efforts. It will also further aid overcoming the so far markedly technical focus of policy development. Developing an interlinked electricity infrastructure may in the long run be difficult without co-ordination among technical authorities, various energy business actors and energy policy shapers and makers. Stronger policy integration may be necessary, paying attention to how the electricity traded via the grid is produced, when, in what quantities and where it is transferred, what kind of solutions are adopted to enhance resilience, for example through microgrids, and what network effects are involved.

- Consider further the prospects for using the Nordic experiences in developing regional and international electricity interconnections and grids elsewhere in Europe and beyond, as well as developing climate and energy policies via lessons learned to other countries.

- Maximise the prospects for regional co-operation in the development of Nordic energy policies and ability to meet climate policy objectives by optimising energy investments in the most promising regions and sites, enhancement of electricity interconnections and optimisation of infrastructure for different energy solutions in the transport sector, including the coordination and planning for emerging solutions (such as availability of biogas filling stations and electric road charging facilities or battery replacement for electrified heavy transport).

- Utilise issues on which broader agreement exists to support the wider process of developing policies and cooperation in the Nordic countries.

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Appendix

Table 1. Nordic renewable energy and emission reduction targets

	Denmark	Finland	Norway	Sweden
Share of renewable energy sources (RES) in final energy consumption (2020-40)	2020: 30%; and 50% of electricity from wind power; 2035: 100% of electricity and heat from RES	2020: 38% 2030: over 50% (incl. peat)	2020: 67.5%	2020: 50% (achieved) 2040: 100% of electricity from RES[b]
National emissions reduction targets[a]	2020: 40% reduction in total emissions vs. 1990; 2050: carbon neutrality	2035: carbon neutrality (political commitment by the Rinne and Marin Governments; 2045: parliamentary agreement); 2050: at least 80% reduction from 1990 levels (Climate Act)	2030: carbon neutrality	2045: carbon neutrality (political commitment)

Sources: Government of Denmark (2011), Ramöverenskommelse... (2016), Valtioneuvosto (2016), EEA (2016), Norwegian Ministry of the Environment (2007)
a = includes own reductions and offsetting with international investments.
b = does not exclude nuclear power

Table 2. Heuristic model of the energy debate used in statement selection

Component of the electric energy system	Interests vis-à-vis the electric energy system		
	a. Resource and energy efficiency	b. Climate neutrality	c. Further interests[a]
A. Production	Aa	Ab	Ac
B. Network	Ba	Bb	Bc
C. Consumption	Ca	Cb	Cc

[a] R&D and capacity building, competition, including energy market development and prices, energy business including its wider economic effects on employment and taxation, security of supply

Table 3. Participant information and respective factor loadings

Participant number, country	Sector	View 1	View 2	View 3
1Swe	interest group/business	0.1585	0.3846	0.4111
2Swe	public	0.1041	0.5241	0.5029
3Swe	interest group/business	0.1979	0.0188	0.3726
4Swe	interest group/business	0.5472X	-0.2863	0.0956
5Swe	business/interest group	0.7233X	-0.0844	0.3600
6Swe	public	0.0394	0.4117	0.3134
7Swe	public	0.4067X	0.1656	-0.0356
8Dk	interest group/business	0.5303X	0.2480	0.3266
9Dk	interest group/business	0.3801	0.5909X	-0.2206
10Dk	public	0.4981	0.4648	0.1568
11Dk	NGO/environment	-0.1261	0.7457X	0.0261
12Dk	interest group/business	0.2764	0.4403	0.0310
13Dk	public	0.7758X	0.2871	-0.0448
14Nor	public	0.1483	0.5170X	0.0974
15Nor	interest group/business	0.3242	0.5724X	-0.1250
16Nor	public	0.2985	0.4167	0.1672
17Nor	NGO	-0.0684	0.6906X	0.1845
18Nor	public	0.7630X	0.1116	-0.0315
19Fin	business/interest group	0.4067	0.0799	0.2671
20Fin	business/network services	0.1963	0.4439	0.4676
21Fin	business/environment	0.2912	0.3961	0.4019
22Fin	business/production and network	0.2282	0.2795	0.6388X
23Fin	business/network	0.4644	0.3210	0.1766
24Fin	public	0.2041	0.6456X	0.1504
25Fin	business/R&D	0.0238	0.3703	0.6131X
26Fin	business/system equipment	0.4590	0.1495	0.5094
27Fin	business/network	-0.1576	0.1920	0.6317X
28Fin	NGO consumers	0.7934X	-0.1097	0.2682
29Fin	public	0.2365	-0.1727	0.5245X
30Fin	business/equipment	0.7022X	0.2885	0.2723
31Fin	public/business	-0.1067	0.0722	0.6125X
32Fin	NGO/consumers	0.6920X	0.1251	0.1996
33Fin	business/interest group	0.3167	-0.3340	0.4930
34Fin	business/production and network	0.3735	0.2437	0.4337
35Fin	business/interest group	0.2178	0.3336	0.3530
36Fin	business/interest group	0.0369	0.5953X	0.1952
37Fin	business/interest group	-0.1548	0.7787X	0.0869
38Fin	NGO/environment	0.1001	0.0054	0.3858X
39Fin	business/interest group	0.0958	0.7685X	0.0349
40Fin	NGO/environment	0.1438	0.3395	0.3272
41Fin	business/interest group	0.3156	0.2239	0.4026
42Fin	business/Interest group	0.5101	-0.0458	0.5114
43Fin	business/network	0.1345	0.0594	0.6681X

Notes: X = Respondent selected for a factor. Criteria: the factor loading must be statistically significant, > 0.37 (1/√48*2.58 (SEr) = 0.37) while the next highest loading of the same respondent on any other factor(s) must be at least < 0.20 than the significant loading. Dk: Denmark, Fin: Finland, Nor: Norway, Swe: Sweden.

Figure 1. Q sorting grid

-5	-4	-3	-2	-1	0	1	2	3	4	5

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