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Policy Brief

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Nordic Energy Research
Nordic Council of Ministers

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Better Policies Accelerate Clean Energy Transition

Focus on energy system flexibility

Seven recommendations to decision-makers to remove market barriers preventing full utilization of flexibility to increase the use of renewable electricity in the Nordic-Baltic region

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SUMMARY

The use of variable renewable energy sources will increase in the Nordic and Baltic countries in the future. This will call for increased flexibility in the electricity market to ensure both high energy security and efficient use of renewable power in all circumstances.

The barriers and hence also policies to energy system flexibility are numerous. In this brief, we focus on policy recommendations for two important barriers to flexibility in the Nordic electricity market, namely insufficient market signals to some stakeholders, and uneven market frameworks for different renewable energy resources.

We present seven major recommendations, which could mitigate the market barriers to flexibility.

A central recommendation is to have better tariffs for electricity and grid use to promote flexibility. This would improve the coupling of access renewable power to other sectors such as heat, transport, and gas, which has a large potential for increased flexibility.

Nordic Flagship Project Flex4RES: Flexible Nordic Energy Systems

Flex4RES is a Nordic Flagship Project funded by the Nordic Energy Research 2016-2019. It aims at demonstrating how high shares of variable renewable energy can be efficiently integrated into the energy system through a stronger coupling of energy markets across Nordic and Baltic regions, thereby facilitating a zero-carbon energy transition. Pathways towards coherent, flexible energy systems encompassing the electricity, heat, gas, and transport sectors are identified by combining technical analysis of flexibility potentials, economic analysis of markets and regulatory frameworks, and energy system modelling quantifying impacts.

Flex4RES investigates how an intensified interaction between coupled energy markets, supported by coherent regulatory frameworks, can facilitate the integration of high shares of variable renewable energy (VRE), in turn ensuring stable, sustainable and cost-efficient Nordic energy systems.

Through a holistic system approach we identify potentials, costs and benefits of achieving flexibility in the Nordic electricity market created by the heat, gas and transport sectors as well as by electricity transmission and generation. Flex4RES develops and applies a multidisciplinary research strategy that combines technical analysis of flexibility needs and potentials, economic analysis of markets and regulatory frameworks, and energy system modelling that quantifies impacts. We develop coherent regulatory frameworks and market designs that facilitate market interactions, which are optimal for the Nordic conditions in an EU context, and identify transition pathways to sustainable Nordic energy systems. Flex4RES will comprehensively discuss and disseminate the recommended pathways and market designs for achieving a future Nordic sustainable energy solution with a variety of stakeholders from government, industry, and civil society.

Note: This document does not represent the official opinion of the Nordic Energy Research or the Nordic Council of Ministers.

Introduction

With an increasing share of power from variable renewable energy sources (VRE) such as wind power, the Baltic and Nordic countries need to better recognise the energy systems challenges that VRE present. We need in particular to ensure adequate *flexibility* in the electricity markets to compensate for increasing supply variations.

In this first policy brief from the Nordic Flagship Project Flex4RES, we discuss a few important barriers to flexibility and possible policies to overcome these. The brief is based on initial findings in the project and focused to a few cases only, i.e. it is not exclusive in all policy options. Also, the brief assumes that renewable power would have a major share of the future electricity markets and fossil fuels would be subject to a CO_2 penalty phasing them out over time.

European Union, Nordic, and national policies as framework for flexibility

The policies in the European, Nordic, and national levels sets the basic political framework for energy system flexibility. The policies may also create barriers to flexibility, though often unintentionally, e.g. by favouring some solutions over others.

The EU framework is of central importance to all Nordic countries, constituting the overall policy framework for all the involved countries. The recent policy framework, which is still under handling, *Clean Energy for All Europeans* [1] (so-called EU Winter Package) promotes flexibility in electricity markets through various measures to ensure the *security* of supply and affordability, while fulfilling the goal of having a *high share* of renewable energy in EU countries.

While the share of renewable electricity is already over 28% [2] of all electricity in Europe, in the Nordic area 37%[3], fossil-fuel-based power production still dominates in the EU, but also helps to secure supply and flexibility in electricity markets. This flexibility option will reduce in the future as EU policies strive to limit fossil fuel use in the future. EU seeks for compensation through new guidelines on flexibility, in which the member states should design a more *flexible power market* through national measures such as smart metering and dynamic pricing (demand-side flexibility) schemes, new regulations for curtailment (supply-side flexibility), and international measures such as new rules for regional power markets. Furthermore, transboundary power transmission capacity will be strengthened to ease handling of local power mismatches.

Flexibility has also received attention on the Nordic level. In a recent high-level report from the Nordic Council (*Nordic Energy Co-operation: Strong today – Stronger tomorrow* [4]) the need of more flexibility is emphasized as part of increasing shares of VRE in the region. The report proposes to develop energy-only electricity markets and

[1] https://ec.europa.eu/energy/en/news/commission-proposes-new-rules-consumer-centred-clean-energy-transition

[2] http://ec.europa.eu/eurostat/statistics-explained/index.php/Renewable_energy_statistics

[3] https://phys.org/news/2017-01-nordic-countries-energy-transition-worth.html

[4] Nordic Energy Co-operation: Strong today – Stronger tomorrow https://goo.gl/yaqiJD

strive for a better functioning European Emissions Trading System (ETS).

The Nordic region has profiled itself as a forerunner in 'green electricity' and in reducing CO_2 emissions. However, energy policies in most Nordic and Baltic countries are still too focused on the traditional policy framework dominated by security and cost of supply in addition to environmental issues, but overlooking the energy system flexibility which is a prerequisite for a successful transition to clean energy. The main aim of the Nordic Flagship project Flex4RES is to fill this policy deficit and to provide recommendations, such as this policy brief, to key decision-makers in the region.

Market barriers to energy system flexibility

While recognizing the regulative role of the European and Nordic policies on any development in the energy sector, including energy system flexibility, Flex4RES project has surveyed barriers in the Nordic and Baltic market [5], which would require the attention of policy makers, decision-makers and key stakeholders, when striving for a *maximum* share of renewable energy in the future electricity markets. There are several barriers with varying importance, but two of these stand above all:

B1: Insufficient market signals for some stakeholders;

B2: Uneven frameworks for different renewable energy resources.

These two barriers limit flexibility in many Nordic and Baltic electricity markets. The policy recommendations are built around these barriers, but also recognizing that the Flex4RES project will touch upon broader policy recommendation in a later stage, when all project outcomes are available. The recommendations outgo from being environmentally sound, socially acceptable, and economically viable.

There are several empirical observations, which support emphasizing the two barriers above. First, policy and regulatory measures are largely protected from electricity market prices, which affects different sectors on different levels and in various ways. For instance, some of the current support schemes to renewable energy sources (RES) are decoupled from flexibility needs.

Second, fiscal policies such as tax exemptions or subsidies often give a comparative advantage to specific energy resources or technologies. This results in distortions in the market. For example, if biomass-based district heating (DH) receives a tax exemption, this would likely increase the comparative advantage of biomass-based units over power-to-heat (P2H) units, which are very effective flexibility options, in particular in connection with DH. In this example exclusive support could promote biomass heat-only boilers over flexible CHP and P2H such as heat pumps and electric boilers. This would decrease the coupling of heating and electricity, which is considered a very effective flexibility strategy with a large potential.

[5] http://www.nordicenergy.org/flagship/flex4res/flex4res-publications/

Policy recommendations to unlock the flexibility potential

As the barriers (B1, B2) relate to respectively inadequate market signal to some stakeholders, market design, and regulations, the policy recommendations need to be linked to the markets and modifications of the present support schemes.

Seven policy recommendations (R1-R7) were identified to positively respond to the barriers addressed as follows:

R1: Create a level playing field for all RES technologies across sectors through consistent fiscal policies;

R2: Implement electricity grid tariffs which allow market signals for flexibility to reach the end-users;

R3: Dynamic taxation of electricity (e.g. restructuring levies and taxes);

R4: Encourage VRE operators to act flexibly using short-term market-based incentives;

R5: Abolish RES support during negative price periods;

R6: Enhance electrification by removing the limitations on using electricity for heating;

R7: Tackle investment risks in flexible individual heating through new financing and private ownership models.

Recommendations 1-7 form a market-based policy framework for decision-makers, which could be used in a strategic context such as updating national climate-energy policies or in reforming policy measures to reflect on changing boundary conditions on the market such as price decrease and market growth of renewable electricity.

Insufficient market signals and uneven frameworks for different renewable energy resources limit flexibility.

Importantly, the set of recommendations need to be applied selectively accounting for the specific conditions of each country, for which reason we cross-checked their relevance for each of the Nordic and Baltic countries. These findings are summarized in Table 1, which indeed shows differences across the region. The specific comments to the policy recommendations are explained in the Appendix.

Table 1. *Flex4RES policy recommendations to mitigate the two barriers to flexibility.*

Recommendations	Related barrier(s)	Denmark	Norway	Sweden	Finland	Estonia	Latvia	Lithuania
R1	B2	■			■	■	■	
R2	B1	■	■	■	■	■	■	■
R3	B1,B2	■	■	■	■	■	■	■
R4	B1,B2	■				■	■	■
R5	B1,B2			■		■		■
R6	B2	■						
R7	B2	■		■	■	■		

B1 = Insufficient market signals for some stakeholders;
B2 = Uneven frameworks for different renewable energy resources

Societal significance

Public attitude to different energy technologies will considerably affect the development of these. Social acceptability is therefore a key factor to consider in parallel to technology development and deployment measures. Currently, the public awareness on flexibility is poor. Likewise, the correlation of flexibility with security of supply has not yet been realized by politicians. Therefore, more intensive dissemination to and communication with key target groups in the Nordic-Baltic region about the role of flexibility, in the overall policy framework towards a sustainable energy system would be advantageous. It is also worthwhile noting the positive job creation impacts from increased use of VRE and flexibility[6,7]. But capturing such benefits will also require increased efforts in energy R&D and Nordic energy cooperation well noted by the Nordic Council[8].

The way forward

The market of wind power and photovoltaics grow fast. Also in the Nordic-Baltic region, variable renewable electricity is foreseen to increase significantly in the coming years, which may cause major challenges in the energy system due to increasing supply variability. Energy system flexibility will be very important to overcome these problems.

As our present energy system is built on technologies of the past, the present institutions and business models overlook flexibility. In practice it is absent in the energy policies of the Nordic countries. This in turn creates inherent institutional and market barriers to flexibility, and also indirectly hampers to capture the true potential of renewable electricity sources.

The aim of this policy brief is to raise the policy awareness about flexibility and to provide initial guidelines to tackle a few important market barriers. Our 'seven policy recommendations' are a good starting point for decision-makers in the Nordic-Baltic region to more carefully revise their policies to enhance flexibility.

[6] https://ec.europa.eu/energy/en/news/commission-proposes-new-rules-consumer-centred-clean-energy-transition

[7] Parliamentary Committee on Energy and Climate Issues, 2014. Energy and Climate Roadmap 2050.

[8] See footnote 4.

The key message conveyed here is to focus on market-based policies, which also could be fiscally beneficial. Revising tariffs, taxation schemes, and subsidy structures is a first-priority recommendation to all Nordic-Baltic countries. For example, a more dynamic taxation or tariff system could increase cheap demand side response. Increasing CO_2 taxes would encourage uptake of flexible renewable sources. Reforming outdated regulation prohibiting electrification of other sectors, could enhance coupling of power, heat, transport, and gas, which would leapfrog the flexibility in the energy system as a whole.

Improved flexibility opportunities are found across all levels in the energy system from producers, interconnectors (e.g. TSO, DSO) to consumers. However, capturing the flexibility potential would require providing a common level playing field to account for the differences among the market actors. Several of our recommendations relate also to this.

Revise tariffs, taxation, and subsidies in Nordic-Baltic countries to increase flexibility

Varying renewable electricity is sometimes considered by the public and policy makers as a risk of energy supply, and as an excuse not to increase the share of the renewables. Introducing flexibility to the political discourse would correct this misconception.

Our policy brief is limited to discussing policy recommendations to a few important market barriers to flexibility. However, we fully recognize that flexibility could also be promoted in other ways such as better cross-border power interconnections or improving the common electricity market, which was originally planned for dispatchable power production. Also, the Nordic peculiarity of a very high share of hydropower and its full use for flexibility would deserve more analysis. The Nordic-Baltic region also has a unique position, as the potential of both renewables and flexibility is huge, and the region is quite coherent. From the EU perspective, there would be a natural leadership role for the region to show the way forward on the EU level as well. This calls for improved collaboration in the region among the decision-makers.

Further work in Flex4RES project will capture more on these features as well and depict the whole pathway to a sustainable energy system by 2050 and elaborate the necessary policy framework to realize this.

APPENDIX: Description of the policy recommendations and country-specific comments

R1: Create a level-playing field for all RES technologies across sectors through consistent fiscal policies;

Fiscal policies such as tax exemptions or subsidies give a comparative advantage to a specific energy resources or technologies (e.g. biomass, wind, photovoltaics). This could result in distortions among market players that can result in penalizing the operation of or investments in flexible solutions. This effect is largely observed across the Nordic and Baltic countries in the policies aiming at supporting the shift from fossil fuels to biomass energy in the heat sector.
In Denmark, biomass used in DH is exempted from taxes whereas flexible P2H technologies such as heat pumps and electric boilers pay electricity tax on the electricity used for heat generation. Similar measures exist in Finland or Lithuania to prioritize biomass energy. This makes biomass heat-only boilers an attractive choice for heat production and eventually decreases the coupling of electricity and heat sectors, and increased flexibility.

R2: Implement electricity grid tariffs, which allow market signals for flexibility to reach the consumers;

Current electricity grid tariffs in the Nordic-Baltic region (and EU) are mainly volume-based, meaning that the grid cost increases with the volume of electricity consumed. This tariff design hampers demand-side flexibility in alleviating the signals sent by the electricity market that flexibility is needed. In addition, current tariffs add on the cost of utilizing electricity to generate heat or in other industrial processes such as power-to-gas with detrimental effect on electrification and the linkage to flexibility from power-to-X. An appropriate restructuring of the tariff design in all countries, either for selected grid user categories or generalized to all users would result in more accurate signals for flexibility.

R3: Dynamic taxation of electricity (e.g. restructuring levies and taxes);

The levies and taxes added to the final electricity bill result in the same effect as the ones depicted in R2, but affect different actors and items of expenditure. Levies mostly concern charges such as the public services obligation (PSO) that is mainly used to fund renewable energies while taxes are considered a State's income. In addition to the aforementioned issues, tax systems can be a barrier to flexibility from prosumers such as in Finland where a double taxation applies to the storage and feed in of electricity in batteries. Suitable restructuring would allow for more flexibility without interfering with other distributional effects.
The recent removal of the Danish PSO in 2017 is considered a positive measure for flexibility and other countries such as Estonia have started to discuss the phasing out of its "PSO". The effective impact on flexibility of this measure is naturally dependent on the relative share of the levies and taxes. While the level of taxes is rather equivalent across the countries, this recommendation is more likely to trigger a visible impact in countries such as the three Baltic countries where the levy share is high rather than in the Nordics where the levies are null or very low.

R4: Encourage VRE operators to act flexibly using short-term market-based incentives;

Contrary to feed-in-premium (FIP) or green certificates, feed-in tariffs (FiT) disconnect the RES operator from market conditions and contribute to increase the need for flexibility. FiT mostly applies to decentralised units in all countries and to a few isolated centralized units such as for CHPs in Latvia and Lithuania.

R5: Abolish RES support during negative price periods;

Apart from the units subject to full-load hour mechanism (that gives the incentive to self-curtailment of generation) in Denmark, current mechanisms do not prevent RES operators to produce during excess production periods with negative wholesale electricity prices. The green certificate scheme used in Norway and Sweden is, however, expected to be modified in this respect.

R6: Enhance electrification by removing the ban on using electricity for heating

R7: tackle investment risks in flexible individual heating through new financing and private ownership models;

With the development of new individual heating systems such as heat pumps, the flexibility potential from small consumers is expected to grow in the region, thus providing new flexibility solutions at the local scale. However, the uptake of these technologies is limited due to high upfront costs. Initiatives such as preferential interest rates granted on dedicated loans or new ownership forms on the equipment between energy supplier and consumer are identified as good practices to alleviate the investment risk in most countries.

Country-specific comments

Denmark

- R1: the DH sector is taxed based on used fuels. Biomass is exempted from taxes on heat generation, whereas P2H (e.g. heat pumps and electric boilers) pay electricity tax on the electricity used for heat generation. This makes biomass heat-only boilers an attractive choice for heat production and eventually decreases the coupling of electricity and heat sectors, and increased flexibility.
- R2: kWh-based tariffs particularly weaken flexibility signals to consumers with heat pumps and DH operators with electric boilers to produce heat. For instance, the average electric grid tariff for a P2H DH plant is 97% based on a kWh charge.
- R3: different electricity taxes increase the cost of electricity. Removal of the Public Service Obligation (PSO) based on the electricity consumption to cover initiatives such as RES support schemes has contributed to a lower tax share of the electricity cost. Other charges and VAT (less relevant to large consumers) still create an extra cost for electricity consumption, which could be restructured to increase the signal effects on flexibility without affecting the state's revenue. The tax exemption on heat waste from industries also has a negative impact on the business case of using heat pumps.
- R4: prosumers with small-scale units such as solar PV still receive a feed-in tariff (FIT) payment that disconnects them from the market conditions.
- R6: electric heating is banned in areas, which are supplied by public utilities (DH, natural gas), excluding low energy buildings.
- R7: P2H technologies are relevant in areas without public energy supply, often with low housing prices and income levels, which deter investments without better loan conditions.

Norway

- R2: grid tariffs are barriers for flexible use of electricity, e.g. in the district heating sector.
- R3: despite the fact that the tax-level is very low and it is a minor part of the electricity costs.

Sweden

- R2: the economy of grid companies has to be considered and all consumers should be treated in the same way.
- R3: tax is a relatively noticeable part of the consumer electricity cost.
- R5: the green certificate scheme should be modified to react to negative electricity prices in the future. A negative price could be a strong incentive to promote flexibility.
- R7: there is great potential for demand-side response particularly through heat pumps, which could be deterred by high costs and high complexity of their deployment.

Finland

- R1: biomass is a prioritised fuel in the heat sector. Abolishing the additional benefits to biomass energy is required to increase competitiveness of alternative energy resources in the market.
- R2: day-night tariffs exist for electric heating systems. However, tariffs need to be based on a shorter period and apply to other sectors as well to promote flexibility.
- R3: double taxation: prosumers pay tax for storing electricity and for using the same electricity.
- R7: individual heating systems are important in isolated regions. Individuals do not directly receive any support for prohibitive heating system investment.

Estonia

- R1: the current biomass CHP electricity feed-in-premium (FIP) as well as the fixed revenue mechanism of the DH tariff structure need to be modified.

- R2: electricity tariffs for residential consumers in terms of €/MWh is fixed as it is only based on night and day tariffs. Other consumers should also pay a certain fee per month for their actual recorded maximum power consumption.
- R3: the tax structure is fixed, although tax is not a large part of the final price.
- R4: no incentives for RES generation with flexibility.
- R5: wind power and to some extent biomass CHP enjoy of high FIP support. Negative electricity prices have not yet occurred, but may be possible if VRE keeps growing.
- R7: this can bring flexible heating systems to replace or complement the current firewood-based individual heating systems.

Latvia

- R1: biomass is supported via FIT for electricity or capacity payments to biomass-fired CHPs.
- R2: electricity market price makes up only a one-third of electricity bills of consumers. Grid tariff is split into two parts, fixed part – connection fee for the connected load, and a volumetric energy part.
- R3: electricity tax is rather low (€1.01/MWh) and some stakeholders such as households and public transportation are exempted from tax. Therefore, the effect of electricity tax is rather small, unless applied to VAT (21%).
- R4: for operation and services, i.e., transmission system operator (TSO) and demand system operators (DSO), as well as the design of additional market mechanisms.

Lithuania

- R2: applicable for DH and larger consumers.
- R3: up to 16% of the PSO funds for thermal reserve capacity, which is a barrier to sectors coupling. Business and large companies have tax exemption.
- R4: removing FIT for CHP.
- R5: removal of FIT payment during negative hours.

This policy brief is based on Flex4RES reports as of November 2017.
The reports are available at http://www.nordicenergy.org/flagship/flex4res/flex4res-publications/

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