Real time flexibility markets

Development of Fingrid's vision on the design of a Finnish flexibility market

On behalf of Fingrid Oyj

14 November 2019

E-Bridge
competence in energy

REAL TIME FLEXIBILITY MARKETS
DEVELOPMENT OF FINGRID'S VISION ON THE DESIGN OF A FINNISH FLEXIBILITY MARKET

EXPLORING THE FULL VALUE OF FLEXIBILITIES

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MANAGEMENT SUMMARY

The electricity supply industry is undergoing a tremendous change. Policy-makers on European and national levels are amending the relevant legislation and regulations to allow for a smooth transition. In Finland, for example, dynamic load control is proposed to be implemented by April 2021, the distribution tariff system shall be revised to promote self-generation and network operators shall make use of available flexibilities to postpone or avoid network expansions.

All these developments will change the interaction of market parties and require a careful review of the current market design. Fingrid set up a project to develop an own vision on how to make best use of the new flexibilities in order to safeguard security of supply and to increase the efficiency of the electricity market. The project consisted of several internal workshops with a wide range of participants. The project also included an exchange with stakeholders from the Finnish industry. The report in hand summarizes the conclusions from the workshops as well as the reactions received from the stakeholders.

The Finnish market design is characterized by stimulating market forces, mainly to achieve the three main targets: (Cost) Efficiency, sustainability and security of supply. With focus on the utilization of flexibilities, the more specific objectives of the Finnish market design are defined as follows:

- The amended market shall generate maximum value for all types of flexibility and being technology-neutral.
- The market shall reflect the correct value of electricity (time-dependent and location-dependent) and shall reduce transaction costs also for small players.
- The market shall contribute to a safe and secure system and network operation by making flexibilities available to the maximum extent possible.
- The market shall also facilitate an efficient and effective TSO/DSO coordination.

These four specific objectives shall contribute to the achievement of the three main targets mentioned above, benefitting all market parties from generation to consumption.

The Finnish balancing mechanism as well as the mechanism of redispatch[1] shall be amended to allow participation of all flexibilities.

By matching these long-term objectives with the current market design, two areas have been identified requiring special attention: Firstly, hurdles exist in the current market allowing not all types of flexibilities to contribute efficiently to system balancing. Secondly, a proper market mechanism for redispatch, providing all types of flexibilities the possibility to generate value by supporting network operations, does hardly exist. These two focal areas have been elaborated in the project.

Ten hurdles have been identified within the current balancing market. These hurdles have been presented and discussed with stakeholders from the industry. The arguably most relevant hurdles mentioned are:

[1] Redispatch is a mechanism where network operators instruct flexibility providers to adjust three take-offs or feed-ins in order to relieve congestions in the network. Redispatch can be performed close to real-time, but may also involve measures in the day-ahead framework.

- Missing rules for independent[2] aggregators.
- The 24/7 on-line data requirement
- The pre-qualification process.

First steps are being made to resolve them.

Balancing shall be made more attractive for flexibilities by amending the balancing products and stimulating self-balancing.

It is important to recognize that flexibilities can contribute to balancing not only by participating in the balancing markets, but also by so-called "self-balancing". In order to ensure that market parties behave in a way that support the physical balancing of the system, the economic incentives must be efficient and effective. The two most important measures to incentivize "self-balancing" are a single imbalance price for all BRPs and aggregators and transparency in real-time about the system balance state and the imbalance price. The single imbalance price shall be implemented by mid-2021 or at latest – together with the adaption of a shorter imbalance settlement period – by end-2022.

The discussion with the stakeholders confirmed the importance to relieve these hurdles. More than 50 % of involved stakeholders believe that better self-balancing would increase more than 50 MW of flexibility in their own portfolio.

Flexibilities may contribute to (system) balancing, but they may also extract value from contributing to congestion management. The term "flexibility market" is often used for the market-based procurement of flexibilities for redispatch.

There is a wide range of different designs of flexibility markets.

The main building blocks of a flexibility market are the flexibility product definition, pricing and procurement mechanisms, activation and settlement. The different design options for these building blocks have been discussed and specified. Based on this, three concepts of a flexibility market have been developed and evaluated. These alternatives are:

- A regulated flexibility market
- A market-based flexibility market, using balancing products for redispatch
- A market-based flexibility market, using ID products for redispatch.

The regulated approach is a system where at least the price of flexibilities offered for redispatch is regulated. For the market-based approaches, two different designs have been distinguished. At one alternative, balancing bids are geo-tagged[3] and are also used for redispatch. At the other alternative, the ID bids are geo-tagged and are consequently used for redispatch.

A set of seven evaluation criteria have been set up and the three flexibility market concepts have been evaluated accordingly. The result is shown in Figure 1:

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[2] An independent aggregator is a new type of energy service provider, which can increase or decrease the electricity consumption of a group of consumers. The aggregator provides flexibilities at the same connection points as traditional suppliers. In order to be able to differentiate the service of an aggregator and a traditional supplier at the same connection point, new mechanisms are required for settlement purposes.

[3] A geo-tag is an additional attribute of a bid, specifying the geographical location. The geographical location may primarily be a connection point to the electrical grid, but may also be an aggregation of connection points, sometimes referred to as "cluster".

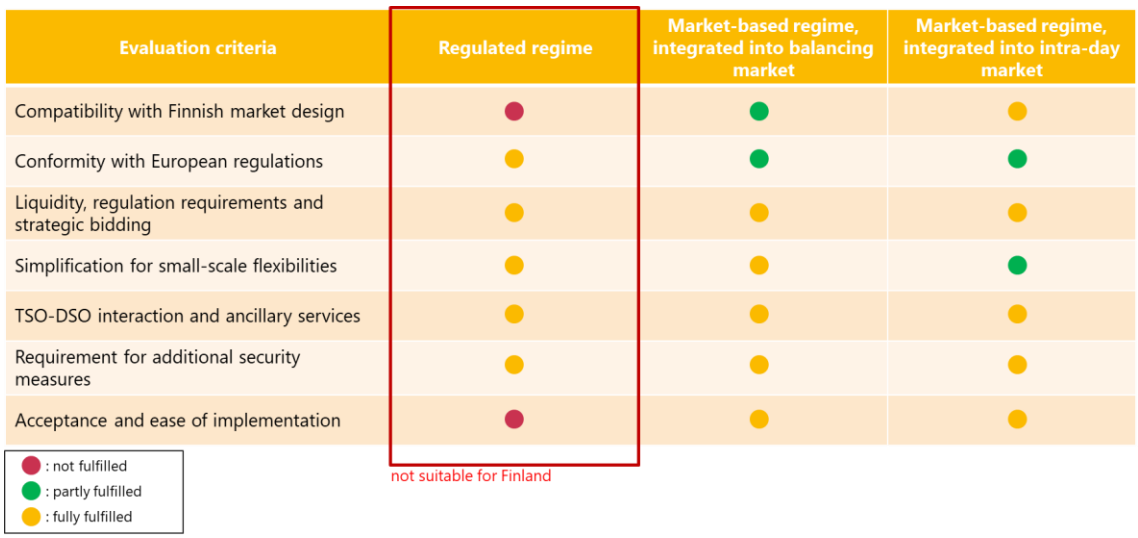


Figure 1: Evaluation of the three options for flexibility market design

A regulated regime for a flexibility market seems not suitable for Finland.

A regulated regime, as e.g. being implemented in Germany, is regarded not suitable for Finland. The main reason is that it is not compatible with the current Finnish market design, which is encouraging competition and relies on market forces. Also, it may not be compatible with the requirements of the Clean Energy Package (CEP) and may fail to get the acceptance of the Finnish electricity industry. This assessment of Fingrid was supported by the Finnish stakeholders, who also do not see the regulated approach suitable for Finland.

Less clear is the evaluation of the two market-based approaches. It is obvious that the flexibility market using balancing products (namely mFRR) is compatible with the current market design. However, it may create higher hurdles for flexibilities to participate in the balancing market as they must comply with special technical requirements and must undergo a stricter product pre-qualification process. A flexibility market with geo-tagged ID products does not have similar technical requirements.

The flexibility market shall be built upon the balancing market (namely the mFRR product) or the ID market.

The flexibility market shall not be implemented as a new and additional market, but is being realized by amending either today's mFRR market or today's ID-market. This assessment is also being supported by the assessment of the stakeholders, who find bother concepts equally suitable for Finland.

Based on the flexibility market design options chosen, E-Bridge recommends implementing the amendments only stepwise. Generally, the actions can be divided into actions with higher priority and lower priority. The actions with lower priority may be implemented at a later stage, e.g. together with the implementation of the 15 min-ISP or even later. An overview of the Road Map is provided in Figure 2:

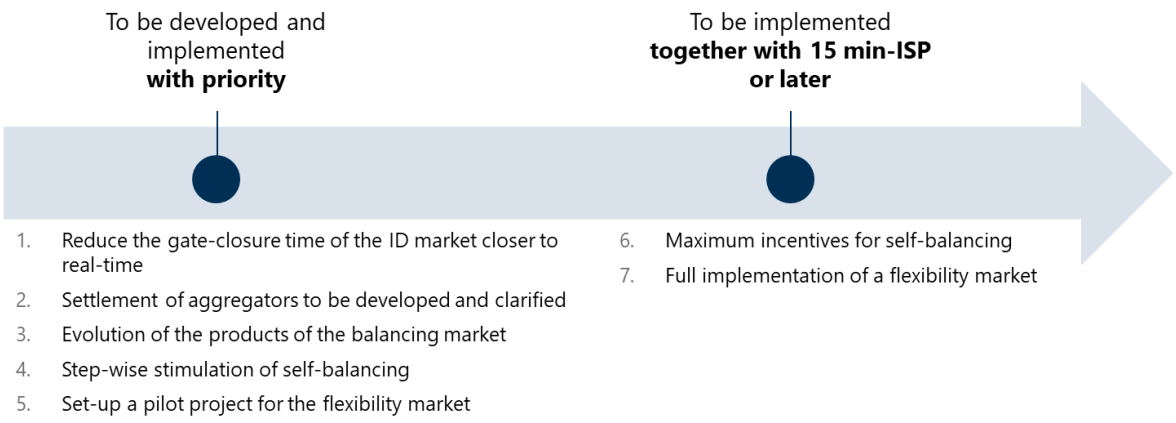


Figure 2: Proposed Road Map for the introduction of Flexibility Markets

The immediate attention should be put on finding an industry-wide consensus on the settlement mechanism of aggregators.

One of the main hurdles that has been discussed by Fingrid and raised by the stakeholders is the missing framework for integrating aggregators into the market. Particularly the settlement of aggregators shall be resolved in an industry-wide arrangement.

Based on this, amendments to the balancing products and the reduction of the gate closure time of the ID markets have high priority. Both issues are recognized and first steps are being implemented.

Beyond this, self-balancing shall be encouraged in a stepwise approach and a pilot project shall be started for a flexibility market for redispatch.

Depending on the experience gained, this shall lead to strong self-balancing incentives and a full flexibility market in the medium-term, allowing all types of flexibilities to contribute to system balancing and congestion management in a coordinated manner.

This phase will be primarily used to enhance the current balancing market, set the first steps to increase the incentives for self-balancing and provide the basis for an integration of aggregators into the market.

In the medium-term, e.g. together with the implementation of the 15 min-ISP, the self-balancing incentives shall be further strengthened and the flexibility market will be fully implemented. This may also lead to a stronger coordination of balancing and redispatch, if needed in the Finnish grid.

1 Scope and objectives of the project

1.1 Background

The electricity supply industry is facing tremendous changes. Following a liberalization process in Europe, which started in the nineties by introducing competition and leading to an unbundling of the generation, transmission and distribution and supply, the industry is on the fringes of a potential technical disruption. The new evolutionary or potentially revolutionary technical challenges are mainly driven by digitalization and the availability of low-cost small-scale generation and storage systems. To cope with these developments, the European Union is amending the regulatory framework and launched the so-called Clean Energy Package (CEP). The CEP provides important amendments to the market rules and even introduces new market roles. Among others, it specifies the role of “aggregators” and requires market-based utilization of flexibilities.

In Finland, the Smart Grid Working Group requires the introduction and implementation of a dynamic load control by 30 April 2021. Also, so-called “energy communities” will be established, trying to encourage consumers to use self-produced electricity. The Smart Grid Working Group suggests among others to eliminate distribution network tariffs and taxes for self-generated and consumed electricity in housing companies and to facilitate the use of self-generated electricity across different grid locations. Network operators shall use the offered flexibilities to postpone or avoid network investments. Furthermore, cyber-attacks may endanger security of supply; market parties and network operators must be enabled to prevent these threats and recover quickly from emergency situations.

All these developments will have a direct impact on the interactions of the market parties – particularly regarding the use of decentralized flexibilities – and requires the amendment of the current market design.

1.2 Objectives of the project and work approach

Fingrid, the transmission system operator in Finland, is, among others, responsible for facilitating the development of the electricity market in Finland. In order to prepare itself for the anticipated changes of the industry, Fingrid has set up an internal project to develop an own vision on the design of a Finnish flexibility market[4]. The project shall address flexibility in the real-time domain leaving the long-term flexibility issues untouched.

The project helps Fingrid to improve its understanding of the related topics, to prepare itself for further discussions with policymakers and other stakeholders and to develop a strategy, if and how real-time flexibility markets shall be implemented in Finland. In particular, the project helps:

- To understand the scope and role of flexibility market initiatives and put them into perspective with the stipulations provided by the Clean Energy Package and the Smart Grid Group of the Finnish Ministry of Economic Affairs and Employment
- To specify market design options to enhance the value of flexibility in the real-time market for system balancing
- To specify and evaluate different market design choices for flexibility markets, enhancing the value of flexibilities for network and congestion management
- To understand the interactions with existing markets and among the various market participants.

The project was designed as an interactive project based on several workshops with a large project group, comprising of all relevant competencies of Fingrid – from system operations to planning and from markets to settlement. The workshops were structured as a mixture of interactive working session and prepared presentations about pre-selected topics.

This work approach does not only ensure a smooth knowledge transfer from international experience, it also ensures that specific issues of Fingrid are adequately addressed and the final recommendations are supported by the majority of the working group members.

Also, the project did not only consist of internal workshops, it also comprised a workshop with external stakeholders. At this workshop, the main design options of possible flexibility markets for Finland were presented and discussed with stakeholders. The response and feed-back has been collected.

The report at hand summarizes the conclusions from the workshops as well as the reactions received from the stakeholders (see Appendix A).

[4] In parallel, Fingrid has started to prepare a cross-border flexible resource project in cooperation with Estonia's transmission system operator Elering AS and Aland's transmission system operator Kraftnät Aland. The aim of the project is to promote the integration of renewable energy into the grid and to increase the flexibility of the power system through investments in flexible resources and smart grid solutions. The project will comprise three parts: the development of cross-border transmission links to enable a cross-border flexible market, the implementation of flexible resource and smart grid investments as well as the implementation of flexible market platforms and related integrations.

2 The need for flexibility markets

2.1 Overview

„Flexibility Markets“ is a buzzword in the European electricity industry. It is conceived as an efficient mechanism to make use of flexibilities in the system. However, there is a large variety of interpretations of flexibility markets. Traditionally, flexibility markets were considered as any market from real-time market for the efficient balancing of the system to day-ahead and intraday-markets for the efficient balancing of portfolios. Recently, the term “flexibility market” is used to describe a market mechanism to procure local flexibilities, mainly for network operators to manage congestions in their grids.

In this report, we will discuss any market mechanism for enhancing the use of flexibilities. This may involve amendments to the current system or even require the establishment of a new market. As most mechanisms trade energy products, the interactions with availability (capacity) contracts are also considered.

In the following, we discuss the main drivers for a flexibility market. Then, we describe the most relevant stipulations from the Clean Energy Package and finally shortcomings of the existing (market) mechanism are being identified.

2.2 Trends and drivers

Costs for decentralized energy systems, such as photovoltaic systems and battery storage systems, have tremendously decreased over the last years. E.g., the costs for battery storage systems have come down by 80% over the last 5 years. This has fostered the business case for PV-self-consumption where it is more attractive to consume locally generated PV energy rather than feeding it into the network. In Germany, every second roof-top PV system is being installed together with a

storage system. By the end of 2018, over 130,000 of such small-scale systems with a capacity of more than 0.4 GW were installed in Germany. Together with an increase in demand by e.g. electric vehicles (EVs), this leads to a reconfiguration of energy flows in distribution and transmission networks. In Finland the expected increase in EVs may have a large impact on the current peak load of 15 GW if the charging simultaneity is not managed. For example, while the smart charging of 1 million EVs only adds some 250 MW to the peak load in Finland, simultaneous charging could increase the peak load by 3.6 to 22 GW depending on the charging power.

As feed-in and load will change, network planning and operations have to adapt to cope with these new flexible assets. While topology changes, new transformers or reactive power facilities can all assist in increasing the so-called hosting capacity, smart active power management will be a key enabler to allow for a high penetration at minimum costs.

It seems there is consensus that the amount of small-scale flexibilities in the Finnish electricity market will increase significantly in the future driven by technological and economic trends (costs of small-scale storage will continue to fall and digitalization allows for the low cost real-time monitoring and control (e.g. of the electric heating in Finland) as well as by political initiatives reducing hurdles in the current institutional framework. Both developments will lead to a steep increase of the availability of small-scale flexibilities connected to the distribution networks and spread over the entire system.

2.3 Stipulations from the Clean Energy Package

The European directives and regulations stimulate the use of all available flexibilities and provide a framework for flexibility markets. In particular, the following conclusions can be drawn:

The demand for and the supply of flexibilities will not only increase due to the general trends described above. Also, the Clean Energy Package (CEP) and the associated Network Codes facilitate the use of flexibilities on all voltage levels.

- Encouragement of information, communication and smart technologies to ensure efficient operation of buildings will boost “supply of flexibility” (Energy Performance in Buildings Directive recast).
- The increase of the renewable energy sources (RES) target to 32%, abolition of grid access and priority privileges of renewables, limited duration of permitting procedures for RES projects and facilitation of Renewable Energy Communities will drive “demand for flexibility”.
- Entitling consumers to become prosumers as well as the facilitation of Renewable Energy Communities will enable small-scale flexibilities to provide flexibilities (Renewable Energy Directive recast).
- The 30/70 rule on cross-zonal capacities (no more than 30% of physically admissible flow capacities may be used for unscheduled flows and reliability margins) [5] will drive the need for coordinated remedial actions and thus the “demand for flexibilities” (Electricity Directive recast).

The use of flexibilities shall be stimulated making use of market–based mechanisms.

[5] The physically admissible flow capacity is the maximum total flow that may occur in order not to violate operational security. E.g., if the total capacity is 1000 MW and 500 MW is needed for contingencies then the remaining 500 MW is the physically admissible flow capacity and 350 MW must then be given to the market. 150 MW is then allowed to be reserved for reliability margins and unscheduled flows (loop-flows and internal flows).

- Disbanding of priority rights of RES require to make these facilities subject to an economic selection process (Electricity Directive recast).
- Changes in the balancing market regulation may encourage the use of flexibilities (Electricity Directive recast).
- The requirement of a market-based redispatch may promote the establishment of flexibility markets (Electricity Directive recast).
- Balancing products may be used for congestion management. Costs have to be separated and flexibilities used for redispatch may not set the imbalance price.
- Where flexibility products can be used for balancing, they must in general be exchanged through the relevant European platforms (Electricity Balancing Guideline).

Making use of all available capacities require improved TSO/DSO coordination

- As many of the new flexibilities will be connected to the DSO networks, but maybe used for TSOs as well, access to and use of these facilities must be well coordinated.
- Recognition of the use of flexibilities as an alternative of network expansions may "weaken" DSO networks and increase the need to coordinate their utilization (Electricity Directive recast).
- TSOs have to agree upon a common framework on how remedial actions against congestions will be selected and activated. Although in capacity calculation only non-costly remedial actions may be included, costly remedial actions for real-time operation shall use a market-based mechanism and may require enhanced TSO/DSO coordination (System Operation Guideline).

The CEP requires also interoperability and accessibility of data

- Updated rules on the exchange of data with suppliers and service providers will impact "TSO/DSO coordination", "settlement and compliance" and "governance and data requirements" through common European interoperability requirements and data access procedures (Electricity Directive recast).

Summing up, the CEP does not require the setting up of flexibility markets but provides a framework that favors and encourages the development of market-based solutions for the use of flexibilities. All requirements focus on a better use of flexibilities. There are almost no requirements with respect to trading local capacities. Most importantly, the CEP sets market-based mechanisms as the standard for congestion management. Non-market-based mechanism may only be used "where the current grid situation leads to congestion in such a regular and predictable way that market-based redispatching would lead to regular strategic bidding which would increase the level of internal congestion."

2.4 Needs for flexibility mechanisms in Finland

Based on the general trends anticipated in Finland and Europe - as well as the requirements put forward by the CEP - the following specific **long-term objectives** of a market design in Finland have been specified with respect to the use of flexibilities:

1. The new/expanded markets shall be appropriate to generate maximum value for all types of flexibilities. Focus is put on small-scale flexibilities as they may pose new and expanded requirements. However, the market must provide a level playing field for all types of flexibilities – small-scale and large-scale as well as being technology-neutral.

2. The new/expanded markets shall reflect the correct value at different times and at different locations. It shall explicitly provide for mechanisms to reduce transaction costs.

3. The scope of the markets shall encompass mechanism to ensure proper system balancing as well as mechanisms to facilitate congestion management. This is important to ensure the flexibilities are made available to the maximum extent possible to ensure safe and secure system and network operations.

4. Independent of the flexibility mechanism, more decentralized resources create the need for TSO-DSO coordination. Such coordination will allow for a more efficient use of such resources.

These four specific objectives help to achieve the main market design targets, being (cost) efficiency, sustainability and security of supply.

Flexibilities can participate in the current market in the balancing mechanism and explore some of the possible short-term values. However, there are still some hurdles, which have been specified by Fingrid's project team. These hurdles involve hurdles to participate in Fingrid's balancing market as well as hurdles to support system balancing by "self-balancing". Suggestions for amending the current market design in improve the value for flexibilities for (system) balancing are discussed in Chapter 5.

In addition to the value flexibilities can generate for balancing, flexibilities may also contribute to network operators, namely congestion management. Today, congestion management does not play a significant role in Finland. Actions by Fingrid are required only rarely (i.e. less than once a month). Fingrid's costs for redispatch (congestion management within the bidding zone) amounted to only 2.2 million Euro in year 2018. Countertrade costs (between bidding zones) were 1.9 million Euro.[6] Redispatch in DSO networks is not current practice. However, congestions may emerge in the future and appropriate solutions are required to making maximum use of all available flexibilities in the system. Possible amendments to the market design to make better use of flexibilities for congestion management are being discussed in Chapter 4.

Finally, Chapter 5 provides a sketch of a possible Road Map to introduce the necessary amendments to the market design.

[6] https://www.epressi.com/media/userfiles/107305/1551951343/siirtojen-hallinta-2018-1.pdf

3 Options to increase the value of flexibilities for balancing

Flexibilities can contribute in two ways to extract value from supporting system balancing. First, flexibilities may offer these services to the TSO, who is ultimately responsible for keeping the system balance. A balancing market has been established, where the TSO can prepare the services required to balance the system.

Secondly, flexibilities are used by the balancing responsible parties (BRPs) to keep the balance of their portfolio and/or to support the system balance. Depending on how “imbalances” are defined and priced, BRPs may have a strong incentive to support system balancing by self-dispatch of own flexibilities.

Flexibility providers will choose where to use their flexibilities in order to generate the maximum value from it. The main hurdles for small-scale and large-scale flexibilities to participate in these markets are described in the previous chapter. Possible amendments to the current market design are described below to ensure that the potential of flexibilities can be fully used.

3.1 Fingrid’s balancing mechanism

European regulations, particularly the System Operation Guidelines (SOGL) and the Electricity Balancing Guideline (EBGL), put partly new and expanded requirements to the Nordic balancing market. These guidelines are being implemented in the Nordic and once compliant, the threshold for flexibilities – and particularly for small-scale flexibilities – to participate in the balancing market will have been lowered, e.g. regarding minimum product size and commitment period for availabilities. The main changes are summarized in Figure 3:

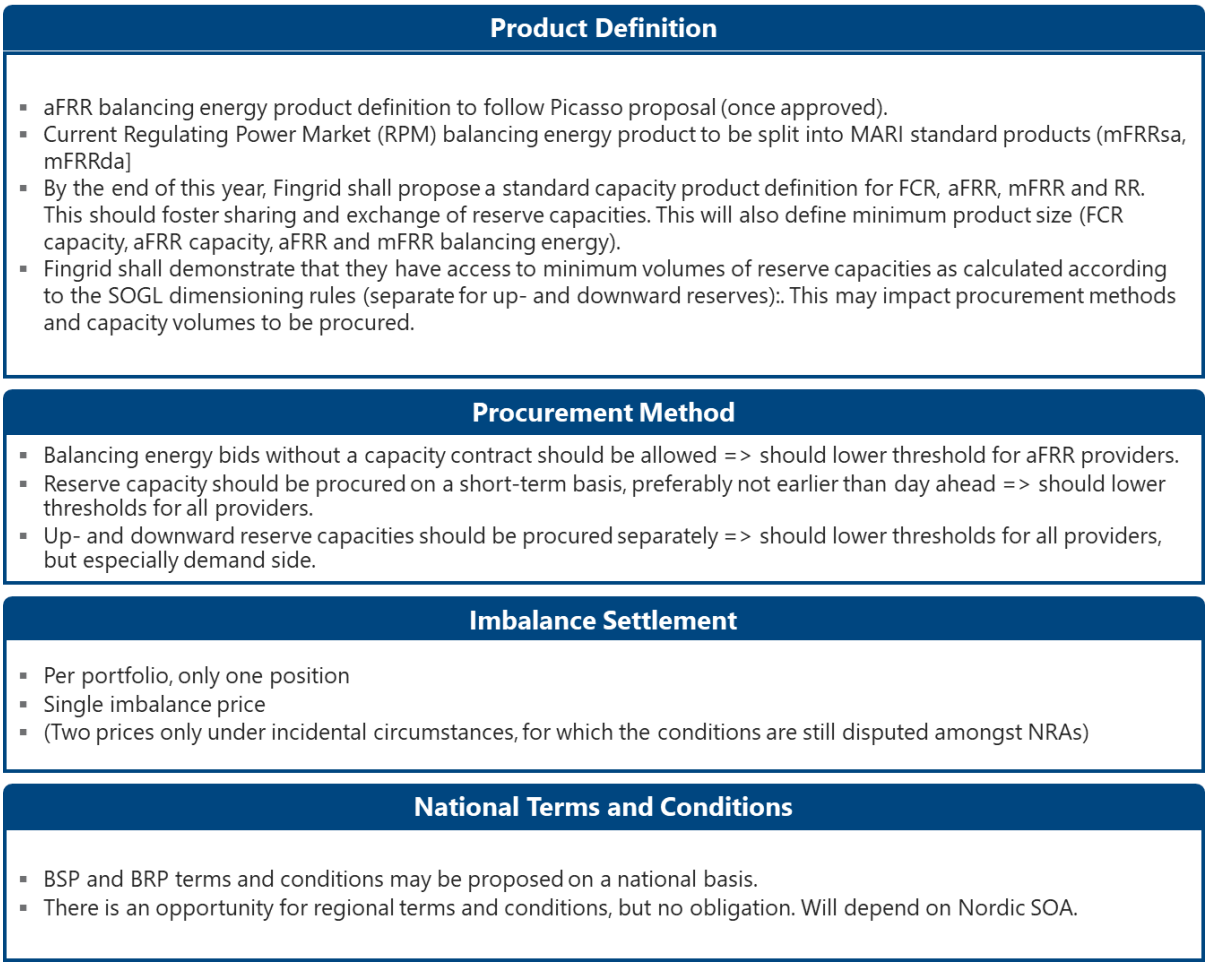


Figure 3: Overview of the main changes to the current balancing market in Finland, imposed by the SOGL and the EBGL

aFRR and mFRR products need to follow the product definition developed within Picasso and MARI, respectively. Capacity contracts need to be standardized to foster the exchange of reserve capacities. Also, Fingrid must demonstrate that it has access to a minimum volume of reserve capacities as provided by the SOGL dimensioning rules.

With respect to the procurement mechanism, balancing energy bids shall be allowed, even if no capacity contract has been concluded. If reserve capacity contracts are foreseen, they shall be procured on a short-term basis, preferably not earlier than day-ahead. Finally, upward and downwards reserve capacities shall be procured separately. These rules certainly lower the threshold of flexibilities to offer their services to the TSO.

A single imbalance price is imposed[7]. The terms and conditions for Balancing Service Providers (BSPs) and Balancing Responsible Parties (BRPs) may be set on a national level, e.g. on the possibility of ex-post imbalance trading. Further stipulations of the terms and conditions may be differentiated by regions, subject to the provisions of the Nordic System Operation Agreement (SOA).

[7] Two-price situations may be allowed under certain operational conditions, subject to regulatory approval of the requirements for such conditions. In general, these are situations in which a single imbalance price would lead to perverse balancing incentives.

Next to these general requirements from the European legislation, several additional amendments to the current balancing mechanism are being proposed, investigated or under consideration. The ten most important ones are described below:

1. **Reduction of minimum bid size in mFRR balancing energy market to 1 MW**

   The current minimum bid size is 5 MW. The NRA has given the permission for 1 MW pilot. Pilot begins on 1st of October. Each market participant is allowed to have one bid which capacity is 1-5 MW.

2. **Reduction of minimum bid size in aFRR capacity market to 1 MW**

   The minimum bid size in the aFRR capacity market will be reduced to 1 MW once the Nordic aFRR capacity market starts. A request for amendments of the aFRR capacity market proposal is expected in Q3, 2019. The aFRR capacity market shall start earliest in Q1, 2020. Positive NRA approval of the aFRR minimum bid size is expected.

3. **Rules for independent aggregators to be implemented**

   Rules for settlement of energy, compensation to BRPs, etc. must be in place to allow independent aggregators to operate in the energy markets. This requires a modification of the existing terms and conditions of BRPs and BSPs with respect to the allocation of volumes, the service fee and the information exchange. Fingrid launched two pilots in the FRR market, one with BRP/BSP and one with third party aggregator. It is envisaged that results are available in 2020 with respect to the need to modify existing terms and conditions.

4. **Simplification of prequalification for multiple units providing similar reserves**

   Today, aFRR requires a prequalification process for a given volume of a reserve providing unit. Change of qualified volume requires a new prequalification. For FCR, the prequalification process has been already simplified as the pre-qualification is only required for one unit at market entry. After that, the BSP can add more FCR volume to bid from identical units without a new prequalification procedure. Further clarification and standardization may be required for FCR and aFRR.

5. **Waiving the need of the 24/7 on-line data availability requirement for mFRR**

   All products currently have 24/7 telemetry requirements. For FCR and aFRR provision a 24/7 online data availability remains required. However, this may not be needed from BSPs delivering mFRR. As this may create an undesired hurdle to flexibility providers to offer mFRR, it may be possible to allow lower availability of real-time data provision and/or to allow off-line provision of metering data for compliance monitoring.

   Another aspect here is the offered interface for real-time data exchange. At present only one interface is offered, which could provide a barrier to small-scale flexibilities, if this interface requires substantial investments or specific IT knowledge. A previous initiative to offer alternative ways for interfacing has been stopped.

6. **Reduction of availability commitment in mFRR capacity market to one day**

   The availability commitment period in the FRR capacity market amounts to 1 week today. The Nordic mFRR capacity market is likely to be reduced to a daily procurement mechanism, which would reduce the availability commitment period to one day.

7. **Facilitate the possibility to transfer availability commitment obligations**

   The EBGL requires the possibility to transfer availability commitment obligations (Art. 34). Today, the transfer of availability commitments to third parties is not allowed. It needs to be discussed and developed with BSPs under what conditions the transfer of availability commitments can best be implemented (special consideration of local management). This might require modifications to the contracts as well as to the supporting IT-systems. The need for this can be considered in the context of a shorter contracting time frame as already foreseen in the Nordic balancing market model.

8. **Improve educational support to small-scale flexibility providers and functionality of electricity markets**

   Limited knowledge about the functionality of the complex electricity markets may create a hurdle particularly for small-scale flexibility providers to participate in the markets. Fingrid organizes already today specific workshops, set up of specific interest groups, bilateral sessions, etc.

9. **Facilitate the contract framework for BSPs**

   Today, multiple contracts are needed for the provision of multiple services. The issue was raised by some BSPs that the set-up of a single contract may reduce the administrative hurdle for BSP and by this reduces transaction costs. It needs to be checked with the stakeholders, if this is really needed to make the balancing market more attractive for (small-scale) flexibility providers.

10. **Separate procurement of upwards and downwards regulation**

    While this is a requirement from the EBGL, it will be implemented in the balancing market in Finland. However, it may create a problem for FCR-N, as currently the same amount of upwards and downwards regulation is required from the same BSP. Aggregation of upwards and downwards regulation separately may create an additional administrative burden and may also create additional risks to the BSPs. It shall be discussed with stakeholders, how this requirement can best be fulfilled to make the FCR-N market as attractive as possible for small-scale flexibilities.

These proposed ten amendments to the current balancing mechanism are summarized in Table 1:

#	Barrier	Solution Direction	Solution covered by EU requirements?	Next step
1	Minimum bid size in mFRR balancing energy market of 5 MW	Pilot with 1 MW minimum bid size allowed starts in autumn 2019	Yes, EBGL minimum product size	The NRA has given the permission for 1 MW pilot. Pilot begins on 1st of October. Each market participant is allowed to have one bid which capacity is 1-5 MW.
2	Minimum bid size in aFRR capacity market of 5 MW	Will change to 1 MW once Nordic aFRR capacity market starts	Possibly EBGL, through the standard capacity product definition	Nordic aFRR capacity market planned to start Q1 2020. Positive NRA decision regarding minimum bid size expected. Request of amendment to the aFRR capacity market design proposal is expected Q3/2019.
3	BSP's current BRP contract doesn't provide sufficient possibility to act as an independent aggregator => Not possible to operate on energy markets as an independent aggregator	Rules for independent aggregator need to be implemented, e.g. regarding settlement of energy, compensation to BRPs, etc. BSPs must be able to engage balancing energy trades with TSO independently	Not explicitly	Modification of national terms and conditions for BRPs and BSPs, e.g.: • regarding allocation of volumes (e.g. baseline for service provision) • regarding service fee for BRP towards BSP • regarding information exchange BRP-BSP Fingrid has two pilots on this: One with BRP/BSP and the other with 3rd party aggregator. Pilots are conducted on mFRR energy market. Plan is to make modifications to terms and conditions after the pilots (in practice earliest 2020)
4	FCR and aFRR require prequalification test for each reserve unit	Clarify and standardize rules for multiple units providing similar reserves so that not each unit needs to be tested separately	No	For FCR this is already solved, qualification of one unit is required at market entry, later BSP can add more volume to bid without new prequalification in case this comes from identical units. Some clarifications on terms and conditions/ instructions might be needed. For aFRR, a similar approach should be considered
5	Availability requirement for BSP data provision too rigid for small-scale units. (real-time, 24/7, one protocol)	Allow multiple industry standard protocols; change from online monitoring to ex-post compliancy checking to allow off-line data provision	No	24/7 real-time data availability remains required for FCR. To be discussed if this really creates a barrier for entry on mFRR and aFRR to small-scale flexibilities. Then the options to change this requirement, especially for small flexibilities, need to be discussed with system operation, particularly in the context of the introduction of ACE control.
6	Availability commitment period in mFRR capacity market too long (1 week)	Daily procurement might be more suitable	No	Include in planning for Nordic mFRR capacity market (discussions are started, timing is unclear). Nordic mFRR capacity market is likely to be conducted with daily procurement.
7	Transfer of availability commitment to third party is not allowed	Allow transfer of availability commitment under specified conditions (limited possibilities for flexibilities that are needed locally, i.e. for congestion management)	EBGL requires possibility to transfer availability commitment obligation (art. 34).	To be discussed with stakeholders in the workshop, if there's a need for transfer of availability commitment. If so, a business case needs to be prepared especially where this requires some IT and contract changes from Fingrid's side.

#	Barrier	Solution Direction	Solution covered by EU require-ments?	Next step
8	Small scale flexibility providers might have limited knowledge of electricity markets	Provide educational support	No	Fingrid organizes already today specific workshops, set up of specific interest groups, bilateral sessions, etc. Feedback from stakeholders is welcomed on ideas of how to improve this further
9	Multiple contracts needed for provision of multiple services from one BSP	Make one contract per BSP for all services to be provided	No	Fingrid seeks feedback from stakeholders on in how far this creates a barrier, especially for small-scale flexibilities and what needs to be changed to solve this.
10	FCR-N is a symmetrical product. Currently same amount of up- and down-regulation is needed from BSPs with the same BRP. It is not possible, for example, to aggregate up-regulation from BSP A with BRP 1 and down-regulation from BSP B with BRP 2. Only valid for FCR-N, not for FCR-D.	Allow aggregation of FCR-N from BSPs with a different BRPs	No, (relevant EBGL art. 32.3 only applies to FRR and RR)	Fingrid is seeking feedback from stakeholders on in how far this creates a barrier and what potential volumes could be unlocked when this is resolved,

Table 1: Barriers and proposed solutions to make the current balancing mechanism more attractive for flexibilities

3.2 Making use of efficient self-balancing

Usually, there is a legal or contractual obligation posed on BRPs to help their portfolio in balance. This legal obligation is supported by financial incentives provided through the imbalance pricing mechanism. BRPs usually behave in a way that they minimize their financial exposure and maximize the potential gain from the imbalance settlement.

If the imbalance pricing is structurally efficient, it incentivizes a behavior of the BRPs that also supports the physical balancing of the system: the BRP receives an award when its portfolio imbalance is in the counter-direction of the system imbalance. Important ingredients of such an imbalance pricing are a single imbalance price (same price for portfolios, which are "long" and "short") and a price that reflects the marginal balancing energy costs. Both are important requirements of the European legislation, namely the EBGL. When a BRP actively controls flexibilities within his portfolio to receive an award for its imbalance, this is called self-balancing. The BRP does not have to do this himself, he may also outsource this or allow a third party , e.g. self-balancing entity[8], to do this. The concept of self-balancing is provided in the figure below:

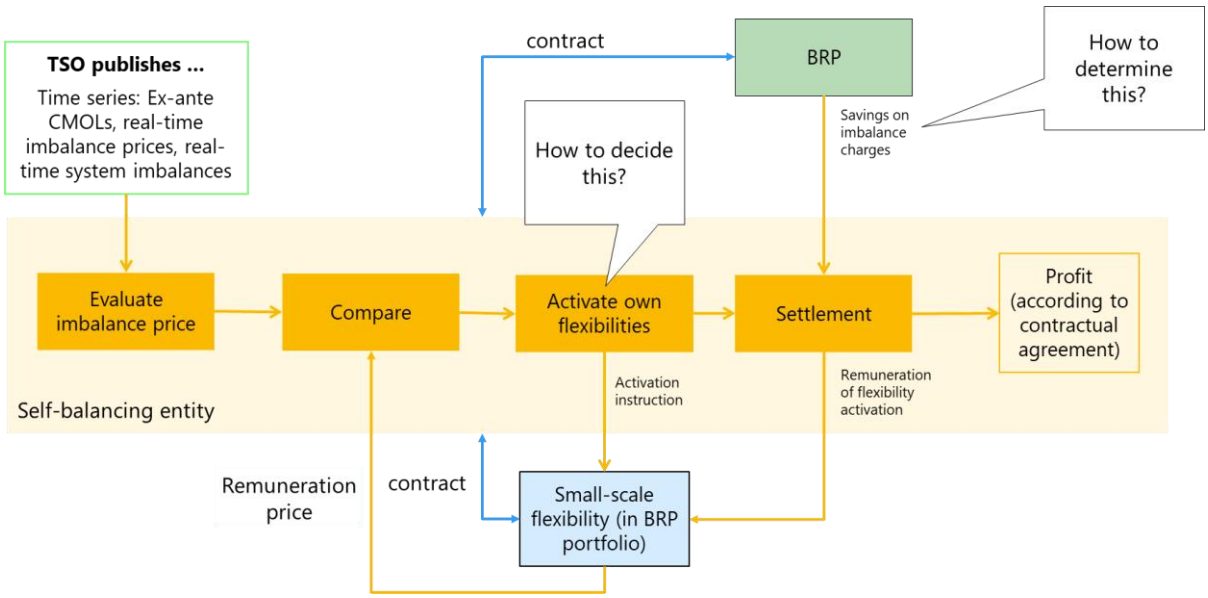


Figure 4: The concept of self-balancing

The self-balancing entity (SBE) must be subject to the imbalance price, i.e. he must manage a part of a BRP portfolio. This may be an entity within the BRP itself or a third party (e.g. an independent aggregator). In case it is within the BRP, no contract is required between the BRP and the self-balancing entity.

The SBE forecasts the imbalance price and the system imbalance direction and the savings on imbalance charges he will receive from the BRP (or as a BRP), compares it with available flexibilities and activation costs of flexibilities and activates the required flexibilities. If the SBE used or activated the flexibility of a third party, the activation costs are the contractually agreed remuneration price with this party. The selection and activation of flexibilities will be done in a way that it maximizes the profit of the SBE. If system imbalance direction is correctly forecasted and the flexibility is activated to counter the system imbalance, the BRP will receive a gain on his imbalance settlement equal to the activated flexibility times the actual imbalance price. The trick is to activate the flexibility in the right direction at a cost that is lower than the actual imbalance price. The risk is over-activation, i.e. when the system balance will change direction during the activation. As this

[8] A self-balancing entity is any agent that increases or decreases feed-ins or take-offs from the grid in order to support the system balance.

will lead to a loss for all involved parties, a self-balancing entity will only engage in self-balancing if he can manage that risk, e.g. by appropriate information on actual system imbalances, centrally activated balancing energies and incidents in the system.

Self-balancing, however, is not undisputed. The active contribution of market parties influences system behavior and may involve the risk of unstable situations. However, it is also important to recognize that "self-balancing" takes place in any system, as long as active control of the portfolio balance has an impact on the market parties' earnings. In order to ensure that market parties behave in a way that support the physical balancing of the system, the economic incentives must be efficient and effective. Self-balancing is actively supported through the close-to-real-time provision of system balance information by the TSOs in Belgium and in the Netherlands.

Two main barriers for self-balancing and corresponding solutions have been identified/proposed:

1. Single imbalance price for all BRPs and aggregators

   The EBGL requires a single imbalance price to be introduced. The current imbalance price is based on a two-price system, with BRPs separated into generator BRPs (to whom currently a two-price system applies) and supplier BRPs (who are already facing a one-price system). It is envisaged that a single imbalance price system will be implemented for all BRPs first part of 2021 or – together with the adaption of a shorter imbalance settlement period of 15 min – end 2022. The imbalance price mechanism must be harmonized among the Nordic countries in a joint Nordic Balancing Model.

2. Improved transparency of system balance state and imbalance costs of BRPs or aggregators

   The EBGL and REMIT require that the following information shall be made public:

   - Activated volume of upward/downward balancing power and highest/lowest activation price.
   - Aggregated volume of offered balancing energies with full activation time of 15 min or less, per product and direction
   - Indicative BRP imbalances and imbalance prices.

   The EBGL requires the publication of this data within 30 min. This may be considered relatively long, if this information shall provide efficient and effective incentives for self-balancing. At least the activated balancing energy volume (or the open loop system imbalance) together with the indicative imbalance price[9] shall be published close to real-time, e.g. for each minute with x minutes (x<5) after the operational minute.

   Some of this data is already published by Fingrid, but not all data and not always in the required time frame. Discussion with stakeholders is recommended on the priority requirements.

It is important to note that the other Nordic TSOs – and maybe other stakeholders – have to get involved in the discussion regarding self-balancing. Cross-border effects of self-balancing on the system balance and on the bidding behavior in other Nordic areas are not known. Analyses performed by E-Bridge on the effect of self-balancing suggest that proper financial incentives assist in improving system balancing and increasing system security. However, in the absence of a

[9] Usually it is not the indicative imbalance price, which is published as such, but the real-time ingredients for the calculation of the imbalance price, such as activation prices and activated volumes of each balancing product, per direction. How the imbalance price is calculated, remains a national jurisdiction. EBGL requires balancing energy to be settled pay as cleared and the imbalance price to be at least equal to the weighted average price of activated balancing energies. Balancing energy pricing is part of the all TSOs' proposals for the implementation frameworks of the European aFRR and mFRR platforms plus the balancing energy Pricing Proposal, all as required by EBGL. All three proposals have been referred to ACER for a final decision to be taken ultimately in January 2020. If the TSO proposals will be accepted without changes, there will be 454 prices and activation volumes for balancing energy during a given imbalance settlement period.

comprehensive analysis of the effect of self-balancing in Finland and the Nordic synchronous area, we recommend increasing the self-balancing incentives carefully step by step and to simultaneously monitor the effect in Finland and the other Nordic countries. The gradual increase of the incentives for efficient self-balancing includes a gradual reduction of the time delay for publication of real-time data. Fingrid started a new pilot in mid July 2019, providing real-time information on mFRR bid activations and prices.

E-Bridge recommends designing and implementing indicators to monitor the effect on the quality of system balancing or frequency, respectively. The indicators may include:

- Sum of scheduled interconnection flows vs. the sum of actual interconnector flows
- Open loop ACE (this is the system imbalance that would have occurred without balancing energy activation).

Also, the SOGL requires the monitoring of the frequency quality and the ACE. The indicators may need to be monitored before and after the introduction of ACE control as well as the introduction of additional measures to stimulate efficient self-balancing. The SOGL also requires to clearly define the dimensioning method and specify how the dimensioning requirements will be met. Fingrid may develop indicators to monitor the impact on the dimensioning requirements as well as on the volume of the voluntary bids.

4 Options of flexibility markets for congestion management in Finland

4.1 Overview

Flexibility markets are being used – among others – by network operators for redispatch to resolve congestions in the network. It is helpful to explicitly distinguish this function from the balancing mechanism (as being discussed in Chapter 3).

It is also important to note that flexibility markets are used to make congestion management more efficient. The main driving point for this is that it is accepted that congestions are structurally accepted as congestion management may be a more cost-effective measure than network expansion. However, it is important that the price signals remain stable and liquidity in the market will not be jeopardized.

Flexibility markets for small-scale flexibilities are new and innovative mechanisms. Hence, many pilots have been set up, but only little experience has been gained so far. In this report, three different flexibility market design options are specified and compared: The regulated regime, the market-based regime, integrated into the balancing market and the market-based regime, integrated into the ID-market. The key differentiation between a regulated and a market-based regime is whether the reimbursement for redispatch is determined by the NRA or through a market clearing mechanism. The three different options are evaluated against a set of general evaluation criteria.

In order to make sure that the most relevant differences are captured when specifying and comparing the different flexibility market design options, we start with a description of the main building blocks and the different design options (Chapter 4.2). Also, we discuss the general advantages and disadvantages of the design options. This provides an overview of the most relevant ingredients of a flexibility market.

Following this, the different design options of the building blocks are put together in three concepts of a flexibility market. The different concepts are compared and evaluated against general evaluation criteria. This provides Fingrid with an overview of the wide range of possible concepts of flexibility markets and their individual ability to meet the pre-selected design criteria (Chapter 4.3).

Finally, a brief discussion on the interactions between the markets, namely the issue of "gaming", i.e. realizing undue arbitrage from interactions between the markets, is performed.

4.2 Building blocks and their design choices

In order to describe the different concepts of flexibility markets, we differentiate four main building blocks:

- Flexibility product
- Trading mechanism and platform
- Activation
- Settlement and compliance monitoring.

An overview of the most relevant building blocks and the associated design options is provided in Table 2:

Building Blocks	Design Options	
Flexibility Product	Incremental vs. maximum	Incremental energy/capacity
		Maximum energy/capacity
	Level of technical requirements	No specific technical requirements (e.g. a 15-min commodity product)
		Specific technical requirements (e.g. start-up times, ramping, delivery period, activation requirements, availability requirements, etc.)
	Type of geographical specification	Nodal geo-tags
		Zonal geo-tags
Trading mechanism and platform	Energy Pricing	Regulated prices
		Market-based pricing
	Capacity Pricing	Regulated prices or obligation to offer flexibility
		Voluntary availability contracts
	Procurement time frame	Operating time frame
		Real-time (< 15 min)
	Trading platform / market place	TSO/DSO-based procurement platform
		Independent platform
Activation/ dispatch	Activating party	Activation by network operators
		Activation by flexibility providers
Settlement and compliance monitoring	Commercial incentives and/or sanctions	Pricing "difference between planned and delivered RD"
		Additional sanction mechanism

Table 2: The building blocks of a flexibility market and the main design options

Flexibility product

The product may be an incremental commodity product (i.e. energy or capacity). This facilitates the trade of the product for the service providers. Alternatively, but less common, is the product definition as “maximum feed-in or take-off” at a certain grid location. In any case, products are separately traded for upwards and downwards regulation.

The product definition of flexibility can be anything, depending on the need of the sellers and buyers. As flexibility in this context is used for redispatch, the technical requirements for real-time response are clearly less critical compared to balancing services. Usually, a flexibility product with a delivering time of 15 minutes is regarded sufficient. The delivery period may even be synchronized to the 15 minutes imbalance settlement time period, i.e. with the commercial trading products. In this case, the flexibility product is “additional feed-in or take-off” at a certain grid location.

Also, specific technical specifications may be defined for the flexibility product. The requirements for an activation are defined by the network operator. Additionally, requirements may specify start-up periods, ramping requirements, delivery periods, availability requirements, etc. Compliance with the specific technical requirements is usually guaranteed/checked by a technical product pre-qualification process, which represents a pre-requisite for the participation in the flexibility market.

The advantage of these technical requirements is that they can be structured to fully meet the needs of the network. The most important disadvantage is that they may create an unnecessary hurdle for flexibility providers to participate in the market. We therefore suggest to carefully study, if additional technical requirements are required at all.

All flexibility products have in common that the bids have a geographical indicator. Flexibilities must be executed at a certain node in the system or within a pre-defined geographical area (so-called congestion zone).

This offers the possibility that sellers of flexibility may buy flexibility back from others to react on changing costs or prices. In the regulated approach, only network operators act as buyers and flexibility providers act as sellers. The decision for a “nodal” geo-tag or a “congestion zone” geo-tag will depend on the ability to define stable zones with similar or equal sensitivities to possible congestions. The main advantage of a congestion zone is that it facilitates secondary trade and therefore reduces the risk exposure of sellers (and potentially of buyers). However, congestion zones are not always easy to implement, as sensitivities shall be similar within one congestion zone. Therefore, congestions in the lowest network areas determine the number and structure of congestion zones.

Trading mechanism and platform

The main design options can be structured into energy pricing, capacity pricing, procurement time frame and platform operations.

An important differentiation is whether energy prices are regulated (i.e. cost-based) or whether they are subject to the bidding strategy of flexibility providers. The most important difficulty associated with regulated prices is a lack of incentives for making additional flexibility available. This applies to generating facilities, but also to consumers. Regulated regimes are therefore usually hardly capable to make full use of the available capacities. This is different with market-based approaches. Market-based regimes create competition between flexibility providers and – by that – stimulate innovations. Depending on the design of flexibility markets, market-based regimes may also provide the possibility for gaming. However, there is a large variety of measures available to limit the risk of excessive gaming.

In case of market-based pricing, the trading mechanism for energy is usually based on a pay-as-bid pricing for the activated energy. It may also be possible to introduce auctions with marginal pricing.

Availability contracts may be concluded in order to ensure that the network operator always has a minimum amount of flexible capacities available. An availability contract is a contract that obliges a bidder to bid into the flexibility market. The capacity payment is a compensation for the costs for making the plant available. However, a concept needs to be developed to clarify how the costs and benefits of availability contracts are shared among the beneficiaries. In regulated regimes, availability contracts shall reflect the costs for making capacity available to the network operator. Alternatively, one may waive regulated capacity contracts at all and make the provision of flexibility obligatory. This is the current practice in Germany. In market-based regimes, the availability contract shall ensure the availability of a capacity, i.e. ensuring the flexibility is offered into the flexibility market. The prices should usually be "left free" to reflect the short-term value of the flexibilities.

The procurement of flexibilities for redispatch may occur in the operating time, starting day-ahead (or even longer before real-time) until close to real-time (until the start of the next ISP). This allows the network operator to make use of flexibilities with long activation times as well as to get access to flexibilities close to real-time. The procurement in the operating planning time frame reflects the need of network operators to coordinate RD-measures before real-time (e.g. in the DACF-processes at TSO level). It also allows hedging price risks in case of a market-based pricing regime. For example, the Dutch pilot GOPACS uses bids with geo-tag from the intra-day market to solve congestions. In this pilot, grid operators (TSOs and DSOs) analyze suitable orders and match them through the platform to cost-efficiently solve the congestion based on price and proximity to the congestion.[10] Procurement in real-time allows the network operator to eliminate the volume risk. In regulated regimes, network operators usually commit themselves to procure flexibility as close to real-time as possible, as they do not have a price-risk. In market-based markets, network operators try to find a balance between volume and price risks. It is also important to have clear rules about the emergency measures that come into force, if there is not sufficient flexibility offered to the network operator. These rules may interfere with a market-based approach and it is important to analyze them carefully when designing the flexibility market.

In case of a regulated mechanism or an integrated market-based mechanism with the balancing market, network and system operators are the only buyers. In this case the market platform may be considered an efficient procurement platform for services for balancing and redispatch. In case of a market-based mechanism with the ID-market, the interaction with the "commodity market" requires special attention. The network and system operators become major, probably even dominant, market players in the ID market and special attention is required with respect to the independence of market party and the market place operator. Also, competition between the market platforms shall always be guaranteed. The impact on the liquidity of the markets needs to be considered and an efficient coordination among the platform shall be established to ensure flexibilities are always sold where they generate the maximum benefit. Fingrid needs to guarantee neutrality against any market platform operator.

[10]https://en.gopacs.eu/wpcms/wp-content/uploads/2019/05/20190228-IDCONS-product-specifications_EN.pdf

Activation of flexibilities

Important for the coordination of the redispatch activities among the network operators is the issue of how the flexibilities are actually dispatched. Basically, there are two options: Either redispatch/activation by the flexibility provider or dispatch/activation by network operators. An activation by network operators requires the implementation of technical interfaces, allowing to be dispatched by network operators. This may be considered an extra hurdle. Alternatively, the activation of the flexibility by the flexibility provider seems to allow a smooth integration into the ID-market, but also requires effective incentive systems to ensure the providers comply with the physical delivery at the designated geographical areas.

Settlement and compliance monitoring

Compliance with the physical feed-in or off-take request at a certain grid location can be incentivized by

- a commercial incentive system or
- a sanction mechanism for non-delivery.

A commercial incentive system is based on comparing planned and actual delivery and pricing the difference. Compliance is measured against a local nomination[11]. This local nomination is the planned delivery in a geographically specified area (i.e. a single metering point or an area with many metering points). In case of an aggregator, a base line determines the planned output. In this case, it is fundamental that the mechanism to determine the base line is set by an industry-wide agreement, ensuring an unbiased calculation of the base line. Also, the prices must be set correctly to provide the proper incentives.

While it may be difficult to develop proper and efficient prices, such a system may provide proper incentives for network-supporting "self-dispatching". Any complex technical dispatch requirements may not be necessary and flexibility providers are incentivized to support the network and – by doing so – reducing the required amount of redispatch energy.

Additionally, a sanction mechanism can be put in place. However, to be effective, a sanction mechanism requires the careful monitoring of compliance. A sanction system must be based on monitoring the technical activation/dispatch process to "prove", if the technical requirements of the activation process are being fulfilled.

4.3 The flexibility market concepts for congestion management

Three concepts will be distinguished:

- The regulated regime;
- The market-based regime, integrated into the balancing market;
- The market-based regime, integrated into the ID-market.

The **regulated flexibility market** refers to a system, where there is an obligation to offer available flexibilities to the network operator for a regulated price[12]. This mechanism is accepted by EU

[11] Local nomination in this context is the planned feed-in or off-take at a certain geographical location.
[12] It may also be possible to make the participation of flexibilities voluntary. In this case, the regulated price must be above the incremental costs of a unit to create sufficient incentives to make it available. In Germany,

regulation only in the case that a market-based approach leads to an inflation of network congestions. A variation of this approach has been implemented in Germany.

The **market-based regime, integrated into the balancing mechanism,** refers to a system, where the flexibility market is integrated into the existing balancing market. The current Finnish system may be regarded as one possible realization of this market concept, as the flexibilities for redispatch are taken from the mFRR bids in the balancing market.

The **market-based regime, integrated into the ID-market,** refers to a system, where a flexibility market is being established next to existing intra-day or integrated into the ID-market. If separated, some mechanism is required ensuring a coordination among the markets. An example of this approach is being implemented in The Netherlands and in several pilot projects, being tested in Germany. An overview of the different design options being discussed is provided in the table below:

		Regulated Regime	Market-based Regimes	
			Integrated with Balancing Market	Integrated with ID Market
Product	Incremental vs. maximum	Incremental energy/capacity	Incremental energy/capacity	Incremental energy/capacity
	Level of technical requirements	Requirements corresponding to underlying product	Technical Requirements (product pre-qualification)	No specific requirements (no product pre-qualification)
	Type of geographical specification	Nodal	Nodal / Zonal	Nodal / Zonal
Trading mechanism and platform	Energy Pricing	Fixed energy prices (regulated)	Variable energy prices	Variable energy prices
	Capacity Pricing	Obligation to provide flexibility	Voluntary availability contracts	Voluntary availaibility contracts
	Procurement time frame	D-1 until real-time	D-1 until real-time	D-1 until real-time
	Trading platform / market place	TSO/DSO-based procurement platform	TSO/DSO-based procurement platform	Independent platform
Activation / dispatch	Activating party	by NO	by NO	by Flex-Provider
Settlement and compliance monitoring	Commercial incentives and/or sanctions	Imbalance plus sanctions	Additional sanction mechanism	Pricing "difference between planned and delivered RD"

Table 3: Design options of a flexibility market, structured into three different market concepts

The flexibility markets may also be distinguished by the type of sellers and buyers. In all market-based approaches, network operators and flexibility providers may participate as buyers and sellers.

The main differences between the market design concepts may be high-lighted as follows:

- The regulated flexibility market has the most specific product and payment requirements, which may create hurdles for participation particularly of demand-side facilities.
- Also, the market-based regime using balancing products for redispatch has strong technical requirements, which may provide hurdles to participate – but to a less extent than the regulated regime. Units are dispatched by the network operator, which limits the possibility of secondary trade.
- The lowest technical and commercial requirements are provided by a market-based approach using ID products for redispatch. There is no technical specification – other than the ones required for participation in the existing ID-market. However, the market may provide enhanced opportunities for "gaming", which need to be carefully reviewed. Also, the concept requires proper incentives to comply with the delivery requirements. Any deviation between planned and

the regulated costs match the incremental costs only. Therefore, offering available flexibilities for redispatch is obligatory.

delivered flexibility must be priced in a way that it creates incentives to fulfil the "contract". The bidding zone-wide imbalance price does not provide the correct signals and it must be ensured that "penalties" are applied to any deviation between planned and actual delivery within a certain geographical location. A pragmatic approach for penalties would be to price any difference between contracted energy and delivered energy with the imbalance price, if it relives the congestions. If the difference increases the congestion, a multiple of the imbalance price should be paid.

The three different concepts are evaluated against a pre-defined set of evaluation criteria. These criteria are provided in Figure 5:

Figure 5: The seven evaluation criteria

A comparison of the three flexibility market design concepts according to these seven evaluation criteria leads to the following results:

1. Compatibility with Finnish market design

The market-based regime, integrated into the balancing mechanism, aligns with the current Finnish mechanism. While a regulated regime would not be in line with current or foreseen future changes, an adoption of a market-based regime, integrated into the ID-market, would be facilitated by the foreseen changes in the Finnish market design (15 min-ISP and trading closer to real-time). In both cases, interfaces and processes to establish locational bidding have to be amended to ensure consistency among the rules of different market processes (i.e. gate opening/closing time, coordination, etc.).

Geo-tagged nominations have to be provided. Deviations from these nominations have to be metered and priced. This will have an impact on the portfolio bids, if congestions exist. For example, there may be a congestion within a bidding zone and dividing the bidding zone into two congestion zones a and b. Geo-tagged nominations for zone a and b have to be provided. The prices to be applied for deviations from the nominations shall depend on whether the deviation increases or reliefs the congestion. A single portfolio bid across both zones may provide opportunities to "game" the system and shall – if portfolio bids shall remain to exist – be carefully monitored.

The balance responsibility may be with the network operator and can also be organized via the market (see GOPACS example above). Countertrades are either organized via the market (see GOPACS example above) or the responsibility of the flexibility provider.

In order to allow for portfolio bids, the "sensitivities" of the flexibility with respect to a congestion needs explicitly to be considered to make flexibilities at different locations comparable. Alternatively, areas are to be defined with similar sensitivities.

2. Conformity with European regulations

Conformity with European regulation includes the conformity with the provisions of the Clean Energy Package. The procurement shall be closer to real-time and in shorter periods in all markets. Cross-border trading shall be facilitated and market-based redispatch mechanisms shall be implemented where feasible. Price and imbalance settlement shall reflect the current situations in the grid. The two market-based approaches are aligned with EU regulation. The regulated regime would need an exception, which can be granted if costs of a market-based approach outweigh its benefits (see CEP).

3. Liquidity, regulation requirements and incentives for strategic bidding

A long-term investment signal into flexibility is only observable if investors believe that premiums at a specific location are lasting. While a regulated regime does not always provide such an incentive due to the likelihood of continuous regulatory interventions, market-based approaches might do so.

Here, the liquidity of the flexibility product plays a key role. Low flexibility volumes lead to no strong signal and firmness of investment signal. An integration into the balancing market compared to the ID-market can be less favorable as technical requirements pose additional hurdles on participation and thus decrease liquidity. As a result, the price signal is less observable and does not provide the right signal for future forecasts that are necessary for investment decisions.

Depending on flexibility volumes, interdependencies occur between balancing or ID and flexibility market and price signals in the balancing or ID markets. Too high premiums might also lead to market intervention from the regulator, which undermines the firmness of the investment signal. Regulator intervention through price caps pave the way towards a cost-based redispatch. However, depending on grid expansion strategy, lasting premiums can foster competition and send an investment signal. Approaches to limit incentives for strategic bidding are discussed in the next section.

A distortion of price signal is not observed in a regulated regime as the approach is cost neutral. However, cost monitoring of small-scale flexibilities, especially with storage systems and loads, is complex and can lead to tremendous controlling efforts.

4. Simplification of participation for small-scale flexibilities:

A key requirement for the flexibility market design is to provide a simple access for (small-scale) flexibilities. This particularly is linked to the complexity of any potential technical product specification as this may be a key barrier for new market entrants. Overall, the transaction costs for flexibility providers shall be minimum. Key enablers for small-scale flexibilities are low technical hurdles and the possibility to integrate them in a larger portfolio, thus leaving specific technical barriers with the aggregator. While a regulated regime and a market-based regime, integrated into the ID-market, can meet the two criteria, using the balancing market highly depends on prequalification requirements and the allowance of pooling.

Market-based approaches can lower transaction and monitoring costs as flexibility prices are not determined based on costs like in the regulated regime, but by bidding strategy. Standardized gateway and interface design further foster low transaction costs in market-based approaches.

5. Impact on TSO-DSO interaction and procurement of additional ancillary services:

Clear rules for prioritization of flexibility access between TSOs and DSOs are required. The possibility to perform preventive and curative congestion management needs also to be ensured as the possibility to guarantee a secure system operation. The regulated regime and the ID-market-based regime allow performing preventive and curative congestion management as products are traded starting day-ahead. The balancing market approach is currently limited to curative measures, which is a disadvantage.

The need for TSO-DSO coordination is impacted through the limitation of potential flexibility providers. Here, mainly capacity requirements influence whether flexibilities for redispatch are even accessible on the DSO level. Thus, the balancing based approach might limit these interactions, which is unfavorable in a future system with larger amounts of decentralized energy systems.

Currently, additional ancillary services are out of scope for all approaches, but processes should be set up to integrate them.

6. Requirement for additional security measures:

It will be analyzed, if additional security measures are required. The future flexibility market should help to reduce the requirements for additional security measures such as a strategic reserve to mitigate extreme events that might threaten security of supply. A regulated regime provides no additional incentive to invest into security of supply and locational based provision of operational security. The market-based approaches can send a positive signal here, if locational price signals are firm enough.

7. Acceptance and ease of implementation:

Public and political acceptance of geographically divergent prices or changing bidding zones is important. The potential increase in security of supply or reduced network expansion may potentially increase the social economic benefit associated with the implementation of flexibility markets.

A regulated regime ensures that market prices are the same for all customers in one bidding zone. For market-based approaches, price differences can emerge. Here, high price spreads across areas are likely to result in acceptance issues.

A summary of the comparative evaluation of the three flexibility market designs is displayed in the following figure.

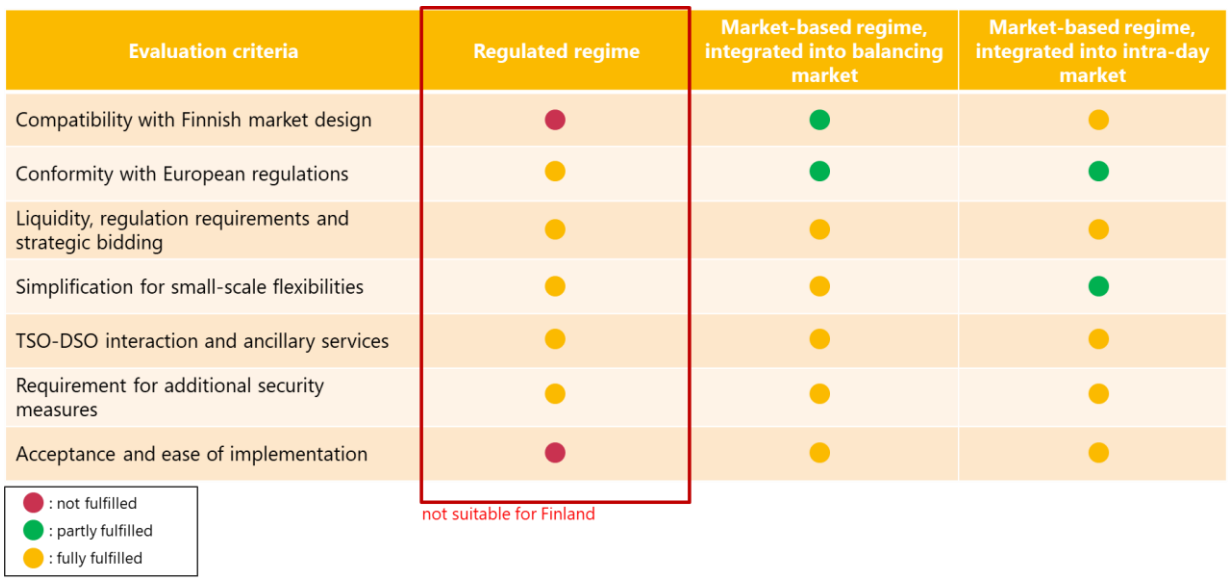


Figure 6: Evaluation of the three options for flexibility market design

The comparative evaluation of the three different flexibility market models lead to the following conclusions:

A regulated regime seems not appropriate for Finland. The regulated approach is hardly compatible with the current market design. An implementation would require an exemption from the EU and would most likely also not be accepted by the society. The reaction received by the stakeholders in the joint workshop, supported this assessment as no stakeholder assessed the regulated approach as suitable for Finland.

Both market-based approaches have pros and cons and a clear "winner" cannot be identified. The flexibility market would be set up on the current practice, i.e. the same products from the balancing market would be used for redispatch. In this case, the rules would not need to be revised immediately and the approach is evaluated to be better compatible to the current market design. However, this does not mean that the implementation would not require additional efforts. The mechanisms for settlement and monitoring of compliance need to be amended to make sure that also small-scale flexibilities, provided by aggregators, can participate. The access of DSO needs to be designed, etc.

Also, using the balancing products (namely the mFRR product) for redispatch creates higher hurdles for small-scale flexibilities to participate and may even involve the need for pre-qualifications. A flexibility market based on a geo-tagged ID-market may facilitate the access of small-scale flexibilities.

The impact on liquidity must in both cases be evaluated with care. We see no advantage or disadvantage for one market-based option against the other. Liquidity must in both cases be an important criterion to be considered when designing the market.

It is interesting to note that the stakeholders assessed both market-based approaches identical. The stakeholders also identified the need to set up a TSO/DSO process to facilitate the usage of flexibilities by TSOs and DSOs. They also suggested including other ancillary services in the coordination mechanism to better manage situations such as faults. It was highlighted that in any case availability contracts are required to ensure the availability of the flexibilities for the network operators.

A settlement mechanism needs also to be developed in an industry-wide consensus for both market-based approaches. The implementation of a flexibility market also requires additional regulatory oversight, independent from the choice of the use of balancing products or using geo-tagged ID products. These regulatory measures include:

- Liquidity in the flexibility market has to be monitored as it ensures stable prices. Price volatility (where justified) is accepted as market-based behavior
- The development of price differences between zonal and local prices has to be monitored. Market concentration and strategic bidding will lead to a distorted price signal.
- Countermeasures to avoid incentives for strategic bidding may be implemented.
- It has to be ensured that sufficient available flexibility is installed for operational security and security of supply. If not, network reserves[13] become unavoidable.

To ensure that the approach works for Finland a pilot phase may be initiated which allows leaving the current mechanism in place and testing the intraday approach in parallel. The pilot phase can be used to clarify and test different design options to ensure an efficient congestion management for Finland:

- **Type of flexibility**: If the flexibility product is delivered as minimum or maximum or as a deviation position compared to a baseline or a schedule.
- **Type of "geo-tag":** If an asset specific flexibility is delivered or a congestion zone is defined.
- **Pricing of deviations from instructed volumes:** What detailed obligations are required for the resource for delivery, e.g. whether a deviation in the right direction is allowed, as proposed by the Dutch approach, or will be penalized.

4.4 Risks of gaming

The introduction of flexibility markets – or the market-based procurement of flexibilities for redispatch purpose – creates the opportunity for market parties for additional arbitrage possibilities. Here, especially influencing the market outcome in favor of the individual gain can be enabled. The so-called Inc/dec (increase/decrease) gaming may lead to inefficiencies in the market. Here, market participants attempt to exploit arbitrage opportunities to maximize the value of their production and consumption flexibility by bidding in an undesirable direction into the spot, intra-day or balancing market knowing that a congestion will appear and then are activated at a higher price to solve the congestion they caused.

Inc/Dec gaming is a valid concern when it comes to energy markets operated with grid constraints. If market parties are able to anticipate congestions in the grid and get remunerated according to a market-based pricing regime, they may adapt a bidding behavior that likely increases the congestion.

A generator at the side of the oversupply anticipates the ramp down requirement and bids below variable costs in the spot market to ensure its market position. At the same time, a generator at the side of the undersupply anticipates the ramp up requirement and bids above variable costs in the spot market to ensure it will be cleared at higher costs. The same is valid for consumers vice versa. If generators anticipate the congestion and get remunerated according to the market price, they would adopt a different bidding behavior, which is likely to increase the congestion:

[13] Network reserves are reserves that are contracted by the network operators for redispatch service. They may not participate in the market.

1. Generators at the side of the oversupply anticipate the ramp down requirement and bid below variable costs in spot market to ensure their market participation[14].

2. Generators at the side of the undersupply anticipate the ramp up requirement and bid above variable costs in spot market to ensure that they will not get cleared at first. Finally, it leads to a situation when the congestion costs are higher than would otherwise be necessary.

It is important to highlight that such a bidding strategy always involves risks. The market party must be able to anticipate the congestion with sufficient certainty. Particularly in meshed networks, this is a complex exercise. Also, one may not forget that network operators have an impact on the load flows in the grid through topology changes, which may change significantly the sensitivity of a power plant on the congestion. Even in case of a reasonably good assessment of the flows in the grid, the actual value of a plant for the redispatch process depends on the network operator's behavior and also involves a significant risk for the gaming party.

Only recently, Energinet and TenneT published a report on the bidding behavior of market parties at the Danish/German border[15]. The report says: "From this monitoring it has been found that certain players actually do buy much less than their requirements during certain periods of special regulation. However, they do not exhibit consistent and systematic behavior, and this is probably because it can be difficult to predict the scope of special regulation with sufficient precision. Any attempt to calculate the scope of under scheduling on an annual basis is therefore subject to great uncertainty. "

Also, there are possibilities to monitor and detect gaming. Even, if there might be some uncertainty about the allowed strategic bidding and the permitted gaming, the threat of even personalized sanctions - in case that gaming is detected - is an effective measure limiting the execution of the full gaming potential.

There are also additional regulatory and market design measures that may be used to curtail the gaming possibilities, the exercise of gaming is regarded excessive and not tolerable. This may include measures such as the introduction of price caps, control positions in non-congested markets and enforce stricter rules.

It should be noted that strategic bidding, as it highly depends on how much market power can be asserted on each node/marketplace.

Summing up, it may be concluded that a strategic misbehavior of market parties is always possible, but existing risks seem to limit the consequences in practice – especially in the case of non-structurally congested networks where congestions are hard to anticipate. It is certainly recommended to carefully monitor the market parties' behavior, but the theoretical gaming risks should not be overestimated.

[14] See Hirth, Lion; Schlecht, Ingmar (2019) : Redispatch Markets in Zonal Electricity Markets: Inc-Dec Gaming as a Consequence of Inconsistent Power Market Design(not Market Power), ZBW – Leibniz Information Centre for Economics, Kiel, Hamburg

[15] DK1-DE Countertrade Following Joint Declaration 2018; Monitoring Report; Energinet, TenneT, March 29, 2019

4.5 TSO/DSO coordination

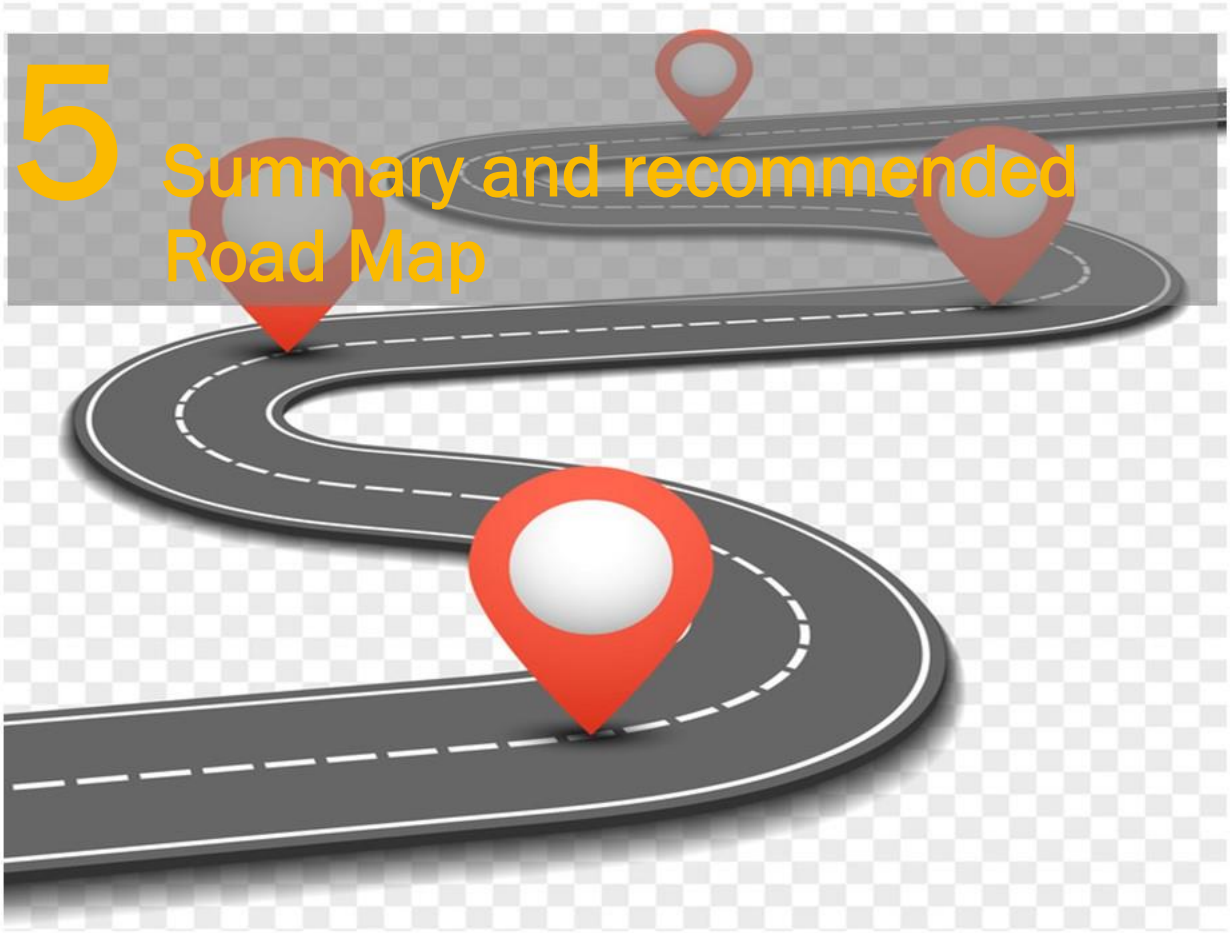
The increasing number of flexible demand, storage and production capacities connected to distribution networks, the growing degree of digitalization allowing to meter and control a large number of facilities as well as the increasing cross-border interconnection capacities require TSOs and DSOs to improve the coordination of their activities. Specific requirements on TSO/DSO cooperation have already been set forth in the different network codes and guidelines.

TSO/DSO coordination deals with the issues of how the flexibilities are used for different purposes and how the access of these flexibilities is coordinated. Basically, flexibilities can be used for system balancing, for relieving congestion and for voltage control in the transmission grid, for relieving congestions and for voltage control in the distribution grid and for balancing the portfolio of market parties. TSO/DSO coordination, with respect to a coordinated access to the decentralized resources, will involve topics such as:

- Priority access rights for certain flexibility use (e.g. should the connecting network operator have priority rights to use the flexibility for congestion management in his own network?)
- Veto rights for the use of flexibilities (e.g. should one network operator have a veto right for the activation of flexibilities by another network operator, when this causes congestions in his network?)
- Will priority access and/or veto rights change over the planning and operating time horizon (e.g. the necessity to introduce priority access or veto rights may change over the D-2, D-1 Intraday or real-time time frames)
- How to coordinate procurement and activation of flexibilities to maximize social welfare or minimize the overall costs?

TSOs and DSOs shall carry out integrated grid analyses to improve and coordinate their active/reactive power management. They shall exchange forecasts of distinguished energy resources to optimize power flows at the transmission/distribution connection points to improve the coordination of the network planning procedures. Also, data needs to be exchanged to provide for an efficient system operation. Data management represents another key element of the “General Guidelines for Improving TSO-DSO cooperation”, prepared jointly by ENTSO-E, CEDEC, EDSO, GEODE and Eurelectric. It is realized that – given the additional requests of observability, granularity and transparency of data – data gathering requires improvement.

The improved coordination in Finland seems to be a less pressing issue. It may be possible to start with a simplified coordination, where DSOs only provide sensitivities of flexibilities in their networks to the TSO and indicate, if an activation of a flexibility must be limited as it may increase a congestion. Currently, this is a very intensively discussed issue in Germany, where a significant level of congestions exists in the distribution network. It may be advisable to start in Finland with a simple coordination mechanism (i.e. DSO indicate sensitivities and a potential limitation of the dispatch of flexibilities due to congestions in the DSO networks) and decide for further going coordination measures as experience will be gained.



5 Summary and recommended Road Map

5.1 Summary of main conclusions

During the course of the project, several workshops have been held with participants covering all affected departments of Fingrid. The objectives and designs of flexibility markets have been discussed. Also, a workshop with stakeholders has been organized in order to collect their views on the need for flexibility markets and preferred design options. Figure 7 summarizes the main findings.

Figure 7: Summary of the main findings

1. The main objective of flexibility markets is to make their full potential available

   The steep decrease of RES and storage costs combined with digitalization and decarbonization will dramatically change the energy industry. A decentralized and volatile energy production and significantly enhanced controllability of the demand will also increase the value of flexibilities. Flexibilities are needed for the portfolio management of market parties and also for system and network management by system and network operators.

   For a safe, secure and economically efficient operation of the system, it is fundamental that all available flexibilities in the system are made available. Flexibility markets shall contribute to this.

2. There is a particular need to make better use of flexibilities for system and network management

   Flexibilities are used by balancing responsible parties (BRP) to manage their portfolios. These flexibilities are traded in the ID-market. The EU regulation sets a number of regulations to improve the ID-markets for BRP, particularly with respect to cross-border trading possibilities. Fingrid is trying to set the gate closure time of the ID-market closer to real-time. A pilot project is envisaged for Q3, 2019.

   However, at least equally important is it to facilitate the participation of flexibilities for system and network operation.

   While the initial trigger of the project was a real-time flexibility market, it became clear already in the early phase of the project that also the value of flexibilities for congestion management shall be enhanced, covering the entire operating time period. There is consensus within the Fingrid project group and the stakeholders that there is a need to

   a. Improve the use of all flexibilities (small-scale and large-scale) for system balancing (i.e. in real-time).

   b. Improve the use of flexibilities for congestion management (i.e. in the operating time frame).

3. **The value of flexibilities for system balancing can be best increased by a further evolution of the "balancing market" and by stimulating "self-balancing".**

   Today's system of balancing services consists of a number of hurdles for flexibilities, particularly for small-scale flexibilities. During the project, the eleven arguably most relevant hurdles have been identified and recommendations for the future development of the "balancing market" have been developed. The list includes issues such as reducing the minimum bid size, waiving the 24/7 online data availability requirement, reduction of availability requirements, etc. Solutions for many of these hurdles have been developed and are being tested – or are planned to be tested – in pilot projects. By a further evolution of the balancing products and the balancing market, the hurdles for (small-scale) flexibilities to participate in these markets will be reduced and more flexibilities may become available for system balancing.

   However, there is another important possibility to make flexibilities available for system balancing: This is not via the TSO-operated balancing market, but by stimulating so-called "self-balancing". Self-balancing refers to the concept that BRP manage their portfolios in a way that this reduces system imbalances. Flexibilities can be used by BRPs to self-balance, in particular, when participation in the central balancing mechanism of the TSO is not possible or too expensive. "Self-balancing" reduces therefore any hurdle to make use of "real-time" flexibilities at the maximum extent possible.

   Stimulating self-balancing requires some changes to the current system in Finland, of which the two most important are:

   - Introduction of a single imbalance price for all BRPs. This is required by the EBGL and shall be implemented in Finland as soon as early 2021 or latest by end-2022.
   - Improved transparency of the system balance state and the imbalance price. This requires the publication close to real-time i.e. some minutes after the operational minute.

   In the absence of a comprehensive analysis of the effect of "self-balancing" on the frequency and cross-border flows in Finland and the Nordic synchronous area, we recommend to only increase the self-balancing incentives step by step and closely monitor the market parties' behavior.

4. **A market-based flexibility market based on ID-oriented products may maximize the value of flexibilities for congestion management.**

   The building blocks of a flexibility market have been identified and the different design options have been described and evaluated. Based on this, three different concepts have been analyzed for making flexibilities available for redispatch: A regulated approach, a market-based flexibility market combined with the mFRR market and a market-based flexibility market combined with the ID-market.

   The regulated approach is not favored by the CEP and is only allowed, if a market-based approach is regarded inappropriate – mainly due to the significant gaming risk caused the high predictability of congestions. It is obvious that gaming risks exist in any market and in flexibility markets in particular, but it could not be demonstrated so far that these risks justify intrusively regulated regimes and miss out the flexibility potential from demand. Experience in other markets show that there are always parties trying to game the system, but that a structured and sustainable misbehavior could not be observed. So far, only Germany favors a regulated congestion management approach. As the current system in Finland is also based on a market-based procurement of redispatch energy, it seems that any future flexibility market in Finland should also be market-based.

A comparison of the two market-based approaches, namely by the integration of the flexibility market into the balancing market or into the ID-market, reveal some important differences. Flexibilities for congestion management do not require an immediate or short-term reaction. A procurement of flexibilities as 15 min-products in the operating time frame is sufficient. Using the current mFRR products, which already foresee some sort of "geo-tags", may be an adequate solution. However, it requires that providers fulfill the technical (product pre-qualification) requirements of participating in the balancing market.

Alternatively, the ID-market may be expanded by introducing geo-tags. The TSO may become one of the large players in the ID market in case of congestions in his networks. The ID market option requires the implementation of an effective pricing/penalty scheme for deviations from the planned flexibility activation. The expansion of the current balancing mechanism seems easier to be implemented in the short-term, but the trade of a geo-tagged flexibility product in the ID-market may put minimum hurdles on flexibilities to participate – they only must ensure physical delivering at a certain grid location. Both ways seem to be sensible to be proceeded by Fingrid.

5. **Network congestions are not an acute problem in the Finnish transmission and distribution grids.**

   Currently, Fingrid does only need to activate redispatch measures a few times per year with an economic value of several million Euros. Congestions in the distribution grids occur also very seldom as the distribution grids are particularly strong due to the high share of electric heating in the system and the solid and successful planning practice.

   This situation provides an opportunity for Fingrid and the market parties to gain experience along with the implementation of the flexibility market.

5.2 Recommended Road Map

Based on the conclusions summarized above and the discussions with Fingrid and the stakeholders, we draw the following recommendations for a Road Map.

1. **Reduce the gate-closure time of the ID-market closer to real-time**

   This pilot is already planned to be launched in Q3, 2019, at least for the Finnish bidding zone.

2. **Settlement of aggregators to be clarified**

   Independent aggregators are important to make flexibilities available to the system. Aggregators make flexibilities at the same metering point as the incumbent supplier. It is important that an industry-wide, standardized mechanism is being in place allowing the settlement of imbalances. For this purpose, a "baseline" is being used and a mechanism to determine "baseline" needs to be implemented. This shall be started immediately, as it is the pre-requisite for all usages of flexibilities. This has also been mentioned by the stakeholders as an important hurdle to be resolved, independent from the future design of the flexibility market.

3. **Evolution of the products of the balancing market**

   System balancing seems to be the most attractive market for flexibilities in Finland in the short run, as only few congestions need to be managed. We recommend discussing the identified hurdles and the developed solutions with stakeholders, create a priority list and an implementation plan. The actions may be implemented in 2020 or latest by end of 2021. The

responses provided by Stakeholders to "Question 1" and "Homework Questions 1-2" may serve as a basis for the future development (see Appendix A).

4. Stepwise stimulation of self-balancing

Self-balancing is regarded an important measure to increase the value for flexibilities. As self-balancing tries to stimulate the behavior of BRPs in a way that supports system balancing, it is important that the ISP is sufficiently short to reflect the system balance situation.

There are several means that shall be prepared in the meantime, before the ISP is reduced to 15 minutes:

- Prepare the introduction of a single imbalance price, i.e. agree on the method and timing with BRPs.
- Prepare on reducing the publication time of the system imbalance closer to real-time.
- Agree a set of indicators to monitor system and market behavior together with the Nordic TSO and Finnish stakeholders and start monitoring the system – preferably as of mid-2020, i.e. well before enhanced incentives for self-balancing become active.
- Investigate persistency of system imbalance within the current 1 hour-ISP asap; If sufficient persistency occurs, consider a pilot self-balancing project starting in 2020 with a supplier BRP to learn about self-balancing strategies that would maximize profit for the BRP while having no adverse impact on the system imbalance.

The responses from the Stakeholders to "Homework Question 3" provide an overview of issues to be solved to further enhance self-balancing. We suggest starting the incentivization of self-balancing only stepwise, e.g. to move the publication of the relevant information closer to real-time in several pre-defined steps.

5. Set up a pilot project for a flexibility market

A pilot project can help to assess the implications of a flexibility market and to help deciding on important design options. The following preparatory work needs to be done:

- **Agree on the geo-tagged flexibility market for congestion management.** It shall be agreed with the Finnish market parties and the power exchange, how to improve the coordination of the mFRR market with the ID market. Geo-tags shall be mandatory for all controllable generation or demand even for those parties, who do not participate in the flexibility market. However, it may be possible to commence the process by making geo-tags only mandatory for those who participate in the flexibility market. However, this does provide opportunities for "gaming" and an appropriate monitoring system needs to be in place.
  The issue of a single or separate market place shall be decided in such a way that liquidity shall be maximized. In the Netherlands the goal is to combine a separate flexibility market for congestion management with the existing ID-market. Also, the Nordic model of NODES foresees a separate market next to the existing market. The mFRR market may be further developed to be more extensively used for congestion management. This would involve a reduction of the technical thresholds to participate in the mFRR market as well as allowing DSOs to use mFRR to relieve congestions in their networks.
- **Coordination among TSOs and DSOs and corresponding data platform.** It is important that the data flows between network operators are well defined and the information of decentralized flexibilities is shared among them. As congestions in distribution networks occur only very rarely, the need of coordination of the activation of flexibilities is not acute. However, it is expected that the need will increase in the future.
  As one may start with a simplified coordination mechanism, e.g. by an information of the DSOs, if the activation of flexibilities in a certain region must be restricted due to congestions, and possibly, by information about the sensitivity of

flexibilities in the distribution grid on connections to the transmission grid – the data and communication design can already be developed.
The most essential question is the need of one or several data hubs and what information needs to be provided to whom. This can be organized centrally or peer-to-peer (similar to the organization of the telecom mobile services). As no experience exists on the data structure, it is strongly recommended to develop the cornerstones of an appropriate structure in Finland, providing the IT structure to react flexible in case the requirements and services change and increase in the future.

- **Treatment of redispatch costs in the incentive regulation.** As redispatch does not play an important role today in the network operators' revenue stream, but may become an important factor in the future, a mechanism shall be discussed and agreed with the regulator about how these costs shall be treated in the incentive regulation mechanism.

These five actions shall be followed with high priority. In order to maximize the value of flexibilities, we suggest two other actions, which may only be implemented in the medium-term, i.e. at the time the 15 min-ISP will be implemented or even later:

6. Maximum incentives for self-balancing

The incentives for self-balancing can be increased depending on the experience gained from the first steps. This finally includes more transparency into the market about the activated and instructed mFRR. Activated volumes and prices of mFRR currently set the imbalance price and therefore should be published as close to real-time as possible. Trips of large generation/demand assets and of interconnectors plus expected trip duration should be published in addition (in as far as not already done so by UMMs). The market can then derive an expected system imbalance direction and price from this information, whatever the length of the ISP. This information can be provided immediately without alignment of the shorter time resolution of the ISP. However, the shorter the ISP, the closer to real-time this information needs to be provided in order to support self-balancing.

7. Implementation of a flexibility market

Depending on the experience gained from the pilot project, a flexibility market shall be implemented in the entire Finnish market. Latest then, the concept of geo-tagged bids and the settlement mechanism for deviations between planned and actual delivery must be developed. There are at least two important design features requiring consent with the market parties and the regulatory authorities. The flexibility market requires geo-tagged bids from the market parties. Associated with these geo-tagged bids, a system needs to be in place to settle any deviations between the planned and actual delivery.

For the settlement of deviations, local nominations are required. Local nominations can be generated by making use of the centralized data hub. The pricing of deviations can be pragmatic, such as being implemented and tested in The Netherlands.

The involvement of the regulator is important as any settlement mechanism will involve costs for the network operators and will have an impact on the network operators' overall revenues.

The "Road Map" is summarized in Figure 8:

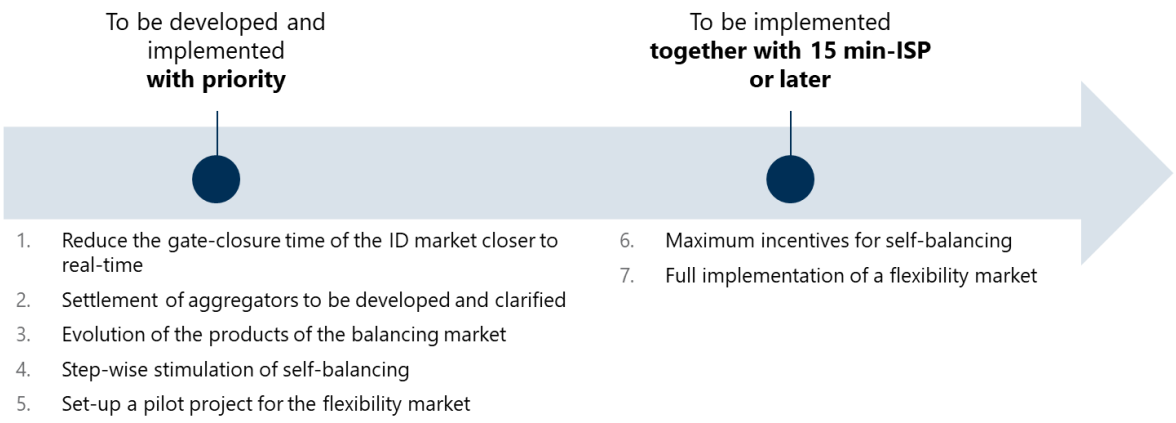


Figure 8: Proposed Road Map for the introduction of flexibility markets

APPENDIX A: FEEDBACK FROM STAKEHOLDERS

A stakeholder workshop was conducted with participants presenting the entire electric value chain. Next to presentations from the stakeholders on balancing and congestion management needs from an industry perspective, interactive discussion sessions were held. The following questions were discussed and answered by the stakeholders.

- Question 1: Which of these 8 thresholds do you consider to be resolved? Please select the top 3.

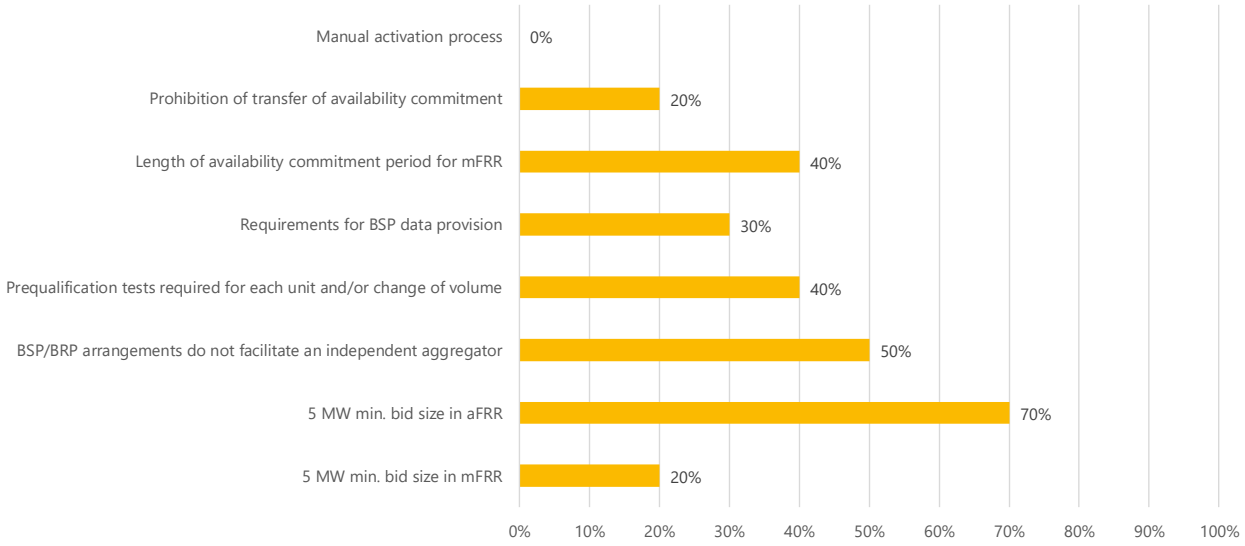


Figure 9: Results for thresholds for balancing market participation

- Question 2: What potential for self-balancing could be unlocked in your portfolio, assuming you could accurately assess the imbalance price and system imbalance direction?

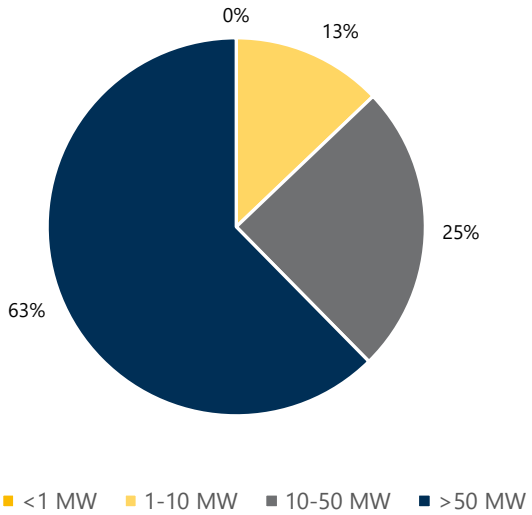


Figure 10: Potential for self-balancing in stakeholder portfolios

- Question 3: How important is the introduction of a new flexibility market for congestion management for you?

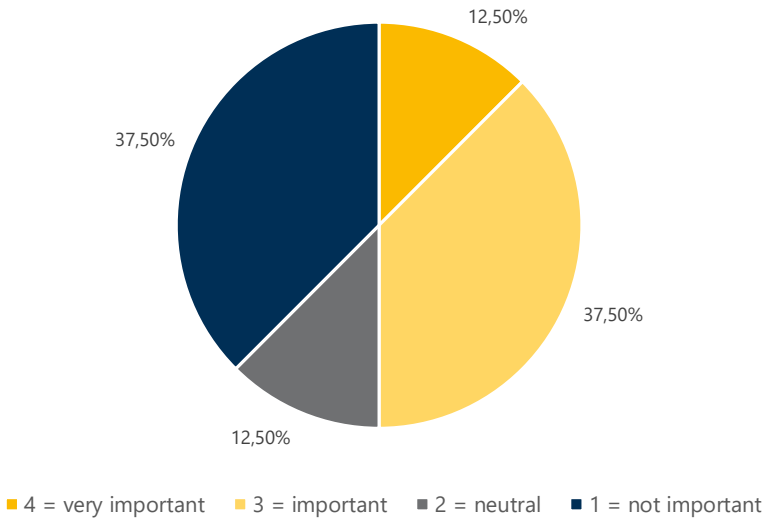


Figure 11: Stakeholder feedback on the importance of a new flexibility market for congestion management

- Question 4: Which flexibility market concept do you prefer?

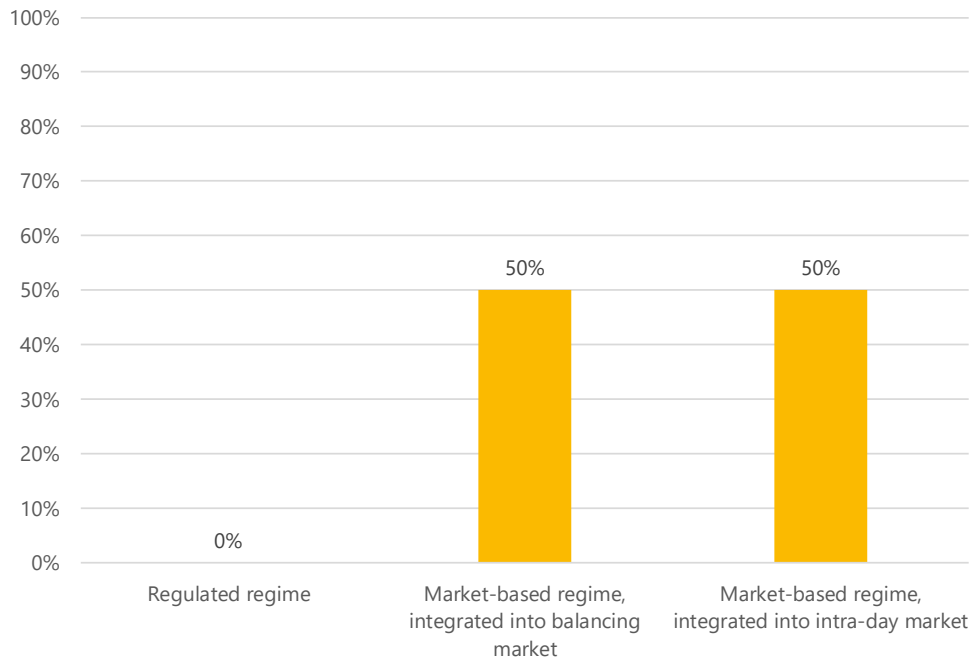


Figure 12: Stakeholder feedback on flexibility market concept

- Homework question 1: Please specify severity of the threshold for you by giving an estimate of how much flexibility could be unlocked if the threshold would be removed (in MW).

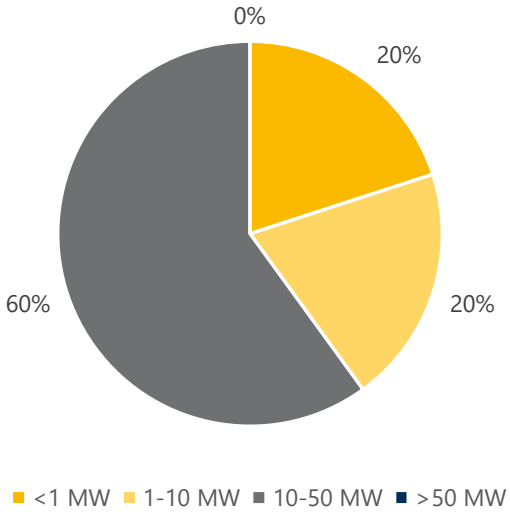


Figure 13: Potential for additional balancing capacity with lower market entry thresholds

- Homework question 2: If you experience other thresholds for participation in the balancing market, please specify them and provide suggestion(s) for a solution.
    - Price signals should be made as real-time as possible so that the traders can provide relevant bids.
    - Pre-qualification criteria should be made as easily accessible as possible in view of as large participation as sensible.
    - With small scale distributed resources, it should be evaluated what requirements are relevant if flexibility should be unlocked. One of those is prequalification process when there might be thousands of separate resources. Another is data requirements. What is relevant from each resource. If real time data requirements are the same for big power plants and small kw-level units that will kill the business. Third is how to unlock flexibility in case where electricity supply and flexibility are provided by different parties. For service provider it is difficult to follow who is electricity supplier or balance responsible party of heat boiler or EV charging pole. This is relevant to at least marketplaces which are short term and based more on capacity than energy. At the moment traditional players can block flexibility. Of course, rules need to be fair.
    - The production plans have to be locked 45mins before production hour. If this were to remove, more adjustments could be made.
    - Too many diverse markets / products. With limited amount of service providers, it does not create a liquid market.
- Homework question 3: Besides the right system balancing information (see slide distributed) and a single imbalance price, what other thresholds do you see to unlock this potential?
    - Merit order list is seen of medium importance for larger generators and very high for aggregator and small-scale flexibilities. Max. delay to real time for system imbalance (high to very high importance) and activated volumes (medium importance) e.g. 1-5 min. Activation prices (medium to high importance) as short as possible. Imbalance price (very high importance) as short as possible. There should also be a system imbalance forecast.

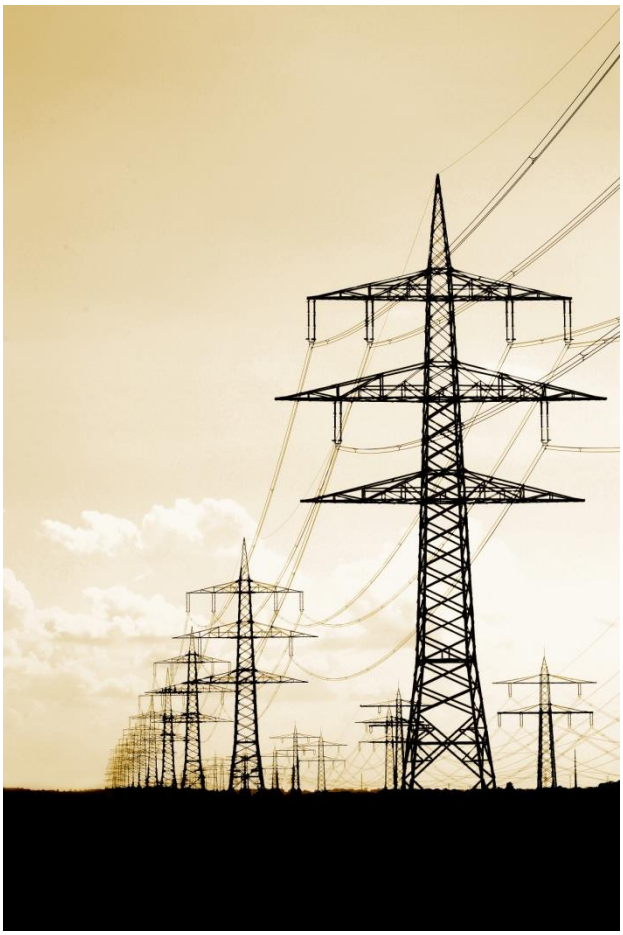
- Uncertainty to invest in technologies where incomes are unsure. If it is hard to know how much capacity is procured, for how long time period etc. Also, the processes are in many ways done for big centralized units. For small resources everything needs to be automated as there are no specific people for sending bids and filling forms.
- Too many products to choose from.
- The time frame is too short. No block orders can be made. For example, a nuclear power plant can indeed adjust its production but the so called restore times are much longer than 15 mins.
- The productions plans have to be locked too early before the production hour. This is a big hurdle.
- "Ideally" elbas or xbid offers should be used also in mFRR , thus the full MOL would always be visible. I am not sure static threshold levels of MW and the prices of those give a representative picture of the MOL. I see a risk that such levels could impact bidding behavior. If used, then I think this should be available before ISP starts. This is a high priority.
- If the imbalance is really the Nordic system imbalance, then the publication of the current system could be valuable. It needs to be cleaned out of any other "impurities" due to FCR N etc. But is also country level imbalance needed? 3 min resolution should be good enough for starts. This is a medium priority.
- Activated volumes and times should be as short as technically possible. This is a high priority.

- Homework question 4: What important aspects would you like to see tested and evaluated in a pilot phase of a flexibility market?
  - Participation of distributed resources and new technology for the market. At the moment it seems that there is not enough knowledge how to handle that kind of resources. Currently all the distributed resources that have participated to Fingrid markets have been part of big companies' portfolios which is totally different case compared to independent service providers. It would also be new topic when resource owners could independently bid to markets via platform by aggregating other companies' resources. So, to say through there might be multiple companies that can bid resources of each other. At the moment roles are quite stable but with this solution one company might have different roles in following market time units.
  - In addition to those already listed, end-to-end testing of trading with aggregated bids.

APPENDIX B: TERMINOLOGY USED

Availability contract	Such a contract ensures that resources need to perform certain services without bidding into the market. They receive a payment independent from the delivery of the services.
Flexibility market	Within this report, the term flexibility market describes a market mechanism to procure local flexibilities, mainly for network operators to manage congestions in their grids. This addresses congestions mainly appearing in distribution systems that can affect the transmission system. Here, flexibility markets aim at facilitating solving these congestions mainly preventively and before real-time.
Geo-tag	A geo-tag is an additional attribute of a bid, specifying the geographical location. The geographical location may primarily be a connection point to the electrical grid, but may also be an aggregation of connection points, sometimes referred to as “cluster”.
Local nomination	A local nomination is the planned feed-in or take-off at a certain geographical location (specified by a geo-tag).
Pre-qualification	Pre-Qualification is the process, in which a potential provider shall demonstrate that it complies with all technical requirements that have been established for the provision of the flexibility product (product pre-qualification) and the ability of the grid to which it connects to deliver the required product (grid pre-qualification). It includes all information and communication technologies, data exchange needs, test, etc. required for the provision of the service.
Real-time market	Within this report, a real-time market comprises measures and mechanisms that aim at ensuring smooth system operation in real-time. Grid operators procure corresponding services to balance the system on balancing markets or incentivize market parties to behave in a system-friendly way.
Zonal congestion area	A congestion area is defined as an area within which flexibilities have a similar sensitivity on a congestion. Such an area can be for example one medium voltage network connected to the high voltage level through a single transformer station.

COMPETENCE
IN ENERGY



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