FEASIBILITY STUDY REGARDING COOPERATION BETWEEN THE NORDIC AND THE BALTIC POWER SYSTEMS WITHIN THE NORDIC ENTSO-E PILOT PROJECT ON ELECTRICITY BALANCING

This feasibility study regarding cooperation between the Nordic and the Baltic power systems was executed by Estonian, Latvian, Lithuanian and Finnish power system operators.

In the event the content of this study is used or quoted by the third parties, an official reference to this study is required.

Introduction to the Feasibility Study Report

In response to the early implementation of the Network Code on Electricity Balancing (NC EB), European TSOs under the umbrella of ENTSO-E and support by ACER initiated a number of activities and pilot-projects. The Nordic TSOs nominated a Pilot Project for Balancing Electricity (Nordic Pilot Project).

Baltic "FEASIBILITY STUDY REGARDING COOPERATION BETWEEN THE NORDIC AND THE BALTIC POWER SYSTEMS WITHIN THE NORDIC ENTSO-E PILOT PROJECT ON ELECTRICITY BALANCING" is carried out within the framework of the Nordic Pilot Project. The main objective of the Nordic Pilot Project is to examine possibilities of the cooperation in exchange of balancing energy from Frequency Restoration Reserve with manual activation (mFRR) between Nordic TSOs and TSOs from neighbouring countries, including Baltic States.

This feasibility study is also considered as a continuation of the work under the Baltic Energy Market Interconnection Plan (BEMIP)[1] where the Baltic Sea countries agreed to work jointly towards opening, liberalising and harmonising electricity market including also the electricity balancing.

Following the requirements set in Regulation 714/2009 concerning common rules for the European internal market in electricity, along with a number of Network Codes also NC EB is being drafted by ENTSO-E. This network code foresees different requirements and activities which the TSOs should follow. The NC EB is still in the development and public consultation phase and may enter the approval or Comitology phase not earlier than early 2015, hence considerable changes might still be anticipated.

Baltic TSOs established a working group (WG) under the Terms of Reference approved by the CEOs of Baltic TSOs in May 2014 to carry out feasibility study with the aim to evaluate possibilities for cooperation between Nordic and Baltic TSOs in exchange of balancing energy from mFRR via Baltic–Nordic HVDC links.

The study work has been carried out by dedicated experts from the Baltic TSOs with involvement of experts from Fingrid as representatives from the Nordic Pilot project.

The study report serves as a step towards further discussion on harmonisation of the Baltic electricity balancing market and possible cooperation with the Nordic balancing market. Also it is a first comprehensive and all inclusive analysis of the Baltic balancing market. It describes the state of the level playing field of balancing markets in the Baltics at the time of this feasibility study. The report

[1] BEMIP Plan is the roadmap towards an integrated power market between the Baltic States and the Nordic Countries. The Plan consists of a stepwise process accompanying the progressive development of the power market in the Baltic area up to its full integration with the Nordic Power market.

outlines also initial ideas and vision about possible evolution of the Baltic balancing market.

The analysis of socio-economic benefits is not included in the scope of this study report. However, the foreseen socio-economic benefits of possible cooperation between thermal power dominant Baltic system and Nordic system with extensive hydro and nuclear resources are evident. The benefits are also reckoned as the result of the internal integration process of the Baltic electricity balancing markets.

The current Baltic mFRR markets contain differences compared with principles considered in the NC EB. This is also relevant to some extent for the Nordic mFRR market. Considering that the process of development and approval of the NC EB is not yet finished, the ideas and visions expressed in this study report still might be a subject for revision and/or gradual modification.

Therefore the views expressed in this feasibility study should be considered only as guiding for further discussions within Baltic TSOs as well as with Nordic TSOs in relation to harmonisation of Baltic balancing market and its future cooperation with Nordic balancing market for mFRR.

The draft proposals and agreed plans of development of common Baltic balancing market and cooperation between Baltic and Nordic balancing markets outlined within this study shall need to be informed and are subject to consultations with market participants and relevant authorities.

Thus this study report should not be relied upon as a statement of the Baltic TSOs' views or as advice in financial, legal or any other matters. There are neither obligations nor liability for Baltic TSOs arising from the contents of this feasibility study report or from the use made thereof.

Executive summary

Based on the analysis and conclusions WG members representing all TSOs engaged within this study (Parties) suggest following guidelines for the deeper cooperation between Baltic and Nordic TSOs towards the final target - common Baltic-Nordic balancing market for Manual Frequency Restoration Reserves (mFFR).

Parties agreed that the Baltic – Nordic balancing market cooperation and developments process should be split into the four steps:

1. Development of current TSO-TSO assistance, incl. testing of new functions and extending TSO-TSO assistance:

Taking into account the foreseen development of Baltic mFRR market the current TSO-TSO assistance between Fingrid and Elering should be further developed and new possibilities for cooperation should be tested. After commissioning of NordBalt DC connection, the cooperation could be extended to take place between Svenska Kraftnät and Litgrid with harmonized principles if agreed between relevant parties. This kind of assistance could also be extended to include a Baltic TSO - Nordic mFRR market cooperation model where it would be possible to activate more mFRR bids than just the bids available in the connecting countries.

2. Creation of common Baltic Balancing Area (incl. harmonisation of the balance management system principles and creation of common balancing market):

A common Baltic imbalance netting solution needs to be implemented as a stepping-stone for the development of the Baltic individual balancing markets into a common Baltic balancing market. Some harmonisation of the obligations, rights and responsibilities of the market participants needs to be analysed and introduced before creation of the common balancing area to secure the efficiency of the market. The main goal for this is to reduce the imbalance energy amount and cost for this service. Topics which need to be analysed includes planning requirements, principles for measurements, etc.

Creation of Baltic balancing market with common Baltic balancing bid merit order list shall encompass following key decisions and implementations:

- Baltic standard mFRR product;
- Baltic standard mFRR product activation procedures;
- common Baltic balancing market settlement procedures;
- common Baltic TSO-TSO balancing pricing, followed with common balance portfolio model and harmonised TSO – BRP imbalance pricing internally in Baltic power systems.

The Baltic balancing market should also include a concept how to co-operate with 3-rd countries power systems. A concept of co-operation with 3-rd countries should be analysed from the broader perspective, taking into account different market set-up in EU and in the 3-rd countries, reciprocity in electricity trading, long-term strategic goals of Baltic States in energy sector and etc. Detailed analysis of the co-operation with 3-rd countries power systems is foreseen in the common Baltic TSOs market study, which at the time of finalising this feasibility study is yet to be carried out by Baltic TSOs.

3. Establishment of deeper cooperation between Baltic and Nordic balancing markets (incl. harmonisation of the products, fulfilling pre-requirements, harmonising the main principles of balancing markets):

The proceedings of Baltic and Nordic balancing market cooperation are subject to the Nordic and Baltic TSOs decision(s) regarding expansion of the cooperation across region and may proceed step by step. Thus, expansion of Baltic and Nordic balancing market cooperation may go in parallel depending on the following developments of Baltic and Nordic balancing markets:

- Exchange of the Baltic and Nordic balancing merit order lists between TSOs for information and testing purposes;
- Harmonization of mFRR product exchanged between FI-EE and LT-SE;
- Creation of the model for cooperation between common Baltic and Nordic balancing markets aiming at common merit order (CMO);
- Decision on cooperation of Baltic - Nordic separate CMO and mFRR product activation and settlement procedures;
- Implementation of the model for cooperation between common Baltic and Nordic balancing markets aiming at CMO and needed IT solutions.

4. Creation of common Baltic – Nordic balancing market:

After having proven and successful operation between the Baltic CoBA and Nordic CoBA, the integration of mFRR markets with similar market setups can be considered as final target. Parallel to the creation of common Baltic - Nordic balancing market also other harmonization processes (such as German, Netherlands, UK and Polish markets) might happen, as the ultimate goal is to have common European-wide balancing market.

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Tables and figures:

Work Package I: Current situation

Possibilities to Develop mFRR Exchange Based on the Current Situation.

This work package contains a description and comparison of the current Nordic, Estonian, Latvian and Lithuanian mFRR and balancing principles and possibilities to develop the mFRR exchange based on the current situation:

1. *Description and comparison of the current practices with mFRR in the Nordic mFRR market and in the Baltics, mFRR product definitions within the Baltics and the Nordics.*
2. *Comparison and compatibility of the existing mFRR products regarding procurement, activation and settlement. For example technical requirements, pre-qualification procedures, firmness of bids, non-obligatory bids, penalties and monetary settlement of non-delivery.*
3. *Pricing of balancing energy in the Nordics and Baltics.*
    - *Pricing principles (pay as bid, marginal pricing, etc.).*
4. *Imbalance energy settlement and pricing principles within the Baltic and Nordic countries.*
    - *Current situation and planned approach.*
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6. *Definition of the limitations and possibilities to develop the exchange of mFRR between the Nordic and Baltic TSOs based on the current balancing market structure in the Nordics and the balancing set up in the Baltics.*

1. Description of the current practices with mFRR in the Baltics and Nordic countries

1.1. Introduction

This chapter provides an overview of the current practices with regard to mFRR (manually activated Frequency Restoration Reserve) in the Baltics and Nordic countries. The mFRR general purpose is frequency restoration with the aim to restore the system frequency in the time frame defined within the synchronous area by releasing system wide activated frequency containment reserves. But these reserves can also be used for other issues related to operational security – for example for counter trading or re-dispatching.

1.2. Balance regulation

1.2.1. Balance regulation in the Baltic power systems

The Baltic TSOs are responsible for planning their own systems into balance hour by hour, as well as for upholding their own balance during the hour of operation. The TSOs collaborate towards minimizing the cost of balance regulation by utilizing, to the greatest extent possible, one another's regulation resources when this is technically and financially appropriate.

Balance regulation is conducted in such a way that the allowed area control error (or system imbalance window) for every TSO is followed. Baltic TSOs must stay within the system imbalance window of scheduled AC net position as follows: Estonia +/- 30 MWh, Latvia +/- 30 MWh, and Lithuania +/- 50 MWh. There is no limit to the immediate imbalance (MW). Actual hourly imbalance energy is traded with an Open balance provider during monthly settlement. The contractual arrangement for the open supply is provided in the figure 1. The selling and purchase price of actual imbalance prices are

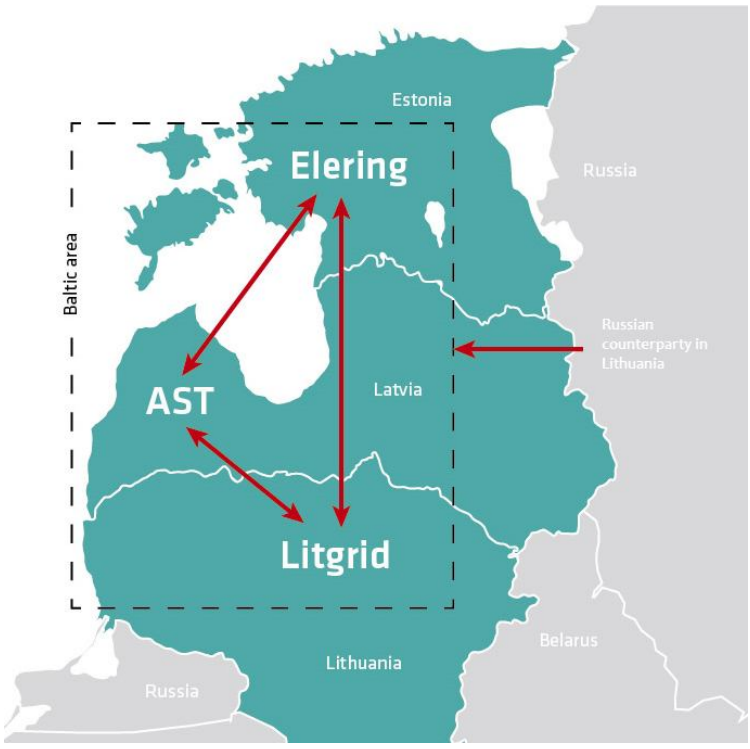

Figure 1: Imbalance energy supply by open balance providers within the Baltic power system

declared by the open balance provider to the Baltic TSOs prior to the operational day when balancing is carried out. The figure below depicts the scheme of imbalance energy supply by the open balance providers within the Baltic power systems.

Latvian and Lithuanian market participants are balance responsible parties in the Latvian and Lithuanian balancing markets and have standard balancing agreements with relevant Baltic TSOs as all other local BRPs , while at the same time they are the open balance providers for the Baltic TSOs; therefore, they gain an advantage over other market participants. Such contractual scheme creates obstacles for further development of a common Baltic balancing market. Therefore Baltic TSOs initiated the process to create common imbalance settlement between Baltic TSOs.

There is no common Baltic merit order regulation list. Every TSO compiles its own merit order list based on the information received from market participants in their responsibility area and from the other TSOs. Balance regulation is conducted in such a way that the cross-border transmission capacity is not exceeded.

1.2.2. Balance regulation in the Nordic synchronous power system

The Nordic TSOs are formally responsible for planning their own systems into balance hour by hour, as well as for upholding its own balance during the hour of operation. The TSOs collaborate towards minimizing the cost of balance regulation by utilizing, to the greatest extent possible, one another's regulation resources when this is technically and financially appropriate.

The basis of the Nordic synchronous power system's balance regulation is that regulation is carried out in respect of frequency. Regulation work is apportioned in accordance with the requirement for frequency response and a joint Nordic merit order regulation list. The entire Nordic power system constitutes a single market for regulation power. In the event of bottlenecks, the regulation market can be split up.

Balance regulation within the synchronous system is conducted in such a way that the quality standards regarding frequency and time deviation are integrated. Furthermore, balance regulation shall be conducted in such a way that the transmission capacity is not exceeded.

The Nordic TSOs cooperate in balancing the system so that the TSOs first settle imbalances between countries among themselves, and then each TSO settles imbalances within its country with the BSPs of the country. According to the Nordic System Operation Agreement, Statnett and Svenska Kraftnat, share the responsibility to balance the joint synchronous system with cooperation from the other TSOs.

In order to handle frequency deviations, there are automatic frequency containment reserves (FCR), which are mainly power stations fitted with equipment that respond automatically to frequency variations. According to the definition of the Nordic TSOs, frequency variations between 49,9 and 50,1 Hz are handled by automatic frequency containment reserves for normal operation (FCR-N) . Response times are required to be 2-3 minutes and the whole region has reserves of this kind of 600 MW. Each TSO is responsible for one part of the total. Deviations between 49,9 and 49,5 Hz, which may be due to disturbances such as power plant shutdown, are handled by automatic frequency containment reserves for disturbances (FCR-D). Response times are 5-30 seconds and whole region has reserves of this kind of 1200 MW. Again, each TSO is responsible for one part of the total.

Frequency restoration reserves (FRR) are used to restore the power balance after deviations during the operating hour and to relieve the automatic reserves. In Nordic power system, mainly regulating power market is used for normal regulation. Regulating power market is energy market where participants have no obligation to maintain capacity[2]. Reserves on the regulating power market are manually activated (FRR-M). In addition, Nordic TSO's maintain automatic FRR-A of total 300 MW in 2014.

In addition to the reserves on the regulating power market, there is a need to secure FRR-M capacity to be able to restore balance after deviations due to disturbances in all situations and to handle situations that would otherwise lead to load shedding. For that purpose, there are separate manually activated frequency restoration reserves for disturbances (FRR-M). These reserves are the last resource to be used to keep the system functioning and consist of for instance TSO's own and leasing gas turbines.

Furthermore, Finland and Sweden have „Peak Load Capacity" - mechanisms that are designed for situations with an extreme shortage of electricity during peak load period in wintertime.

1.3. General overview of current practices with mFRR in the Baltics and Nordics

1.3.1. Current practices with mFRR in the Baltics

There are two types of mFRR in the Baltics – emergency (fast disturbance) reserves and balancing reserves.

[2] There is a both contracted and non-contracted bid on the RPM list. During winter Statnett contract capacity to ensure enough available bids on the RPM list

Emergency (fast disturbance) reserves

- Emergency reserves are used for instance in cases of n-1 criterion violation, e.g. tripping of generator(s) or power line(s), in case other means of regulation are utilized, when other means of regulation cannot be used due to technical reasons.
- The emergency reserves must be shared among the Baltic TSOs in order to be ready for instance for dimensioning faults. Information about the capacities and energy prices is exchanged between the TSOs in accordance with bilateral agreements.
- According to the Belarus-Russia-Estonia-Latvia-Lithuania (hereinafter - BRELL) loop synchronous area system operations arrangement, all Baltic TSOs must maintain at least 100 MW of fast disturbance reserve capacity. Each Baltic TSO has the right to maintain additional reserve capacity.

However, emergency reserves are not the focus of the current study.

Balancing reserves

Balancing reserves are used for compensating the Area Control Error (ACE) or for remedial actions.

- Balancing reserves are offered to the Baltic TSOs by market participants. The capacities of these reserves are not procured in advance and market participants can offer or decline to offer the bids for balancing energy freely.
- Information about the bids for balancing energy in the TSO´s responsibility area is exchanged between AST, Elering and Litgrid in accordance with bilateral agreements; however, rules and procedures are not harmonized.
- Market participants provide balancing services to relevant Baltic TSOs under terms and conditions of bilateral agreement. There are different approaches regarding the capacity of the bids of balancing reserves.
- There is no common IT solution for information exchange. Every Baltic TSO has its own IT-solution for balancing reserve management with no common data exchange format.
- Commands for the activation of balancing reserves are given by the TSO's control room personnel directly to the power plants in their own responsibility area. TSOs are not allowed to give orders to power plants outside their responsibility area directly, but only through the control room of the respective TSO.
- As a rule, mFRR should be fully activated within 15 minutes after activation.

1.3.2. mFRR exchange in Baltics

- Activation, operational coordination and reporting is performed by TSOs while payment is performed according to bilateral agreements between market participants and the relevant TSO.
- In Estonia and Latvia, the capacity of balancing reserves which have been offered by market participants, however not purchased in advance (not paid by TSOs) is not firm, i.e. market participants have no responsibility to guarantee the availability of this capacity for a specific operational hour.
- Data exchange regarding balancing reserves with the market participants and other TSOs is customized and there is no unified data exchange format.
- In Lithuania, standard terms and conditions are defined for the bilateral agreement of balancing services between the market participants and the TSO. Bids by market participants are binding – in case the offer is activated the energy must be delivered, otherwise there will be an imbalance for the market participant. Data exchange regarding balancing reserves with the market participants and other TSOs is customized and there is no unified data exchange format.

1.3.3. Current practices with mFRR in the Nordics

- The Nordic mFRR market is a multinational market for mFRR according to the European target model.
- The mFRR market is primarily used to control the frequency. The market creates a trustworthy price, which is used as a reference price for balancing and for imbalance settlement. The bids on the mFRR market are also available and used for congestion management, however in such case activated bids do not define the imbalance price.
- The mFRR market is a single buyer hourly auction where the TSOs select from a common Nordic list of bids (volume, price and location). Producers and consumers can participate in the market and submit bids concerning their capacity (production or load) which can be regulated in fifteen minutes.
- The participating producers and consumers give their bids on voluntary base. They can give and adjust their bids until 45 min before operating hour. The balancing bids are activated in merit order taking into account congestions at the bidding area borders. The cheapest up-regulating bid is used first, and correspondingly, the most expensive down-regulating bid is used first.
- The rules of the mFRR market are largely harmonised, but there are some national differences.
- The Nordic TSOs occasionally activate non-Nordic bids from Germany, Poland, and Estonia for the same regulation purpose as the mFRR bids are activated. Furthermore, the Nordic TSOs also activate their own mFRR resources as a result of requests from non-Nordic TSOs.

- The Nordic TSOs have agreed to keep fast disturbance reserves at least equivalent to the largest dimensioning fault. The TSOs pre-contract the capacity and offer it to the mFRR market. The activation price of the fast disturbance reserves bids is not harmonised.

1.3.4. Current practices with mFRR exchange between the Nordics and the Baltics

- mFRR exchange is currently conducted between Elering and Fingrid via DC connections between Estonia and Finland in accordance with bilateral agreement. Exchanged bids are balancing energy bids from Estonian and Finnish market participants. There is also the possibility to exchange mFRR from the activation of fast disturbance reserves.
- The balancing energy bids of the Estonian market participants are sent by Elering to Fingrid in advance. The balancing energy bids from the Finnish market participants are not known for Elering in advance. When needed Elering can ask for regulation and Fingrid provides a tentative price for the regulation. The final price for the activated regulation will be known after the operational hour has passed (h+1).
- In case of mFRR activation the planned power flow through the DC connections is changed "manually" by TSOs depending on whether up or down regulation was ordered.
- Activation of mFRR is only possible within the available capacity on the DC connections, and provided that the operational situation in Finland and Estonia enables it.
- There is no common IT solution for information exchange. The data exchange between Elering and Fingrid is based on e-mails.
- Commands for the activation of reserves are given by the TSO's control room personnel directly to the power plants (or to producers' central control room) which operate in the respective TSO's responsibility area. TSOs are not allowed to give orders to power plants outside their responsibility area directly, but only through control room of the respective TSO.

2. Comparison of the current practices with mFRR in the Baltic and Nordic countries

2.1. Comparison of the current practices with mFRR

The second chapter gives the comparison of the current practices with mFRR in the Nordic mFRR market and in the Baltics. In the tables below, the information about the existing Baltic balancing mFRR products, regarding activation, monitoring, settlement and about some technical requirements is provided. Also, the current everyday practices of individual TSOs are described.

The following is the summary of the main differences in the current practices between the Nordic mFRR market and the Baltics. A detailed comparison can be found in Annex 1.

- The main difference between the Baltic and Nordic TSOs in the procurement scheme is due to the different set up – the Baltic TSOs procure balancing mFRR products according to bilateral agreements (Estonia and Latvia) or from the local balancing market (Lithuania), and the Nordic TSOs procure mFRR products from the regional balancing market;
- In the Baltics, mFRR products are provided by generators. The demand side is not represented. One reason for that is the small amount of suitable industrial loads and the absence of aggregators. However, some Baltic market participants representing the demand side have recently expressed interest to join the balancing market, having the possibility to do so. The Nordic countries have both generation and load entities participating in the mFRR market;
- Product resolution in MW varies from "no minimum bid size" to 10 MW. In Estonia and Lithuania, the minimum bid step size is 1 MW. Product resolution in time is one hour, except for Latvia, where it is 15 minutes;
- There are no limitations for the minimum delivery period for standardised mFRR in Lithuania, Estonia and the Nordics. However, in Latvia, the minimum delivery period depends on the type of activated mFRR product (15 min. 30 min, 45 min or 60min).

The following is the summary of the similarities of the current practices between the Nordic mFRR market and the Baltics:

- Approach towards symmetrical products in the Nordic and Baltic countries is the same;
- Products are activated on the basis of the merit order list;
- Activated products are monitored through real-time and hybrid;
- Products are offered for both up regulation and down regulation;
- The full activation time of the product is within 15 minutes;
- Products can be used for re-dispatching and counter-trading.

2.2. Current practices in exchanging mFRR bids for balancing energy between the Baltic TSOs

The following table contains details on current practices in exchanging mFRR bids for balancing energy in the Baltics.

Table 1: Current practices in exchanging mFRR bids for balancing energy between the Baltic TSOs.

mFRR providers	Gate closure for submitting bids	Power	Price	Min order	Activation time
Elering	power and price; preceding day @16.30; amendments up to 45 minutes before the operating hour	tentative	conclusive	1MW (bid step)	within 10 minutes, exceptionally within 20 minutes
AST	power and price; preceding day @17.00; amendments latest 45 minutes before operating hour	tentative	conclusive; prices provided per regulation duration (min 15 minutes, min 30 minutes, etc)	10 MW (bid step)	Not specified
Litgrid	power and price; preceding day @16.30; amendments latest 45 minutes before operating hour	tentative	conclusive	5 MW	Not specified

Comments: each TSO proposes a custom mFRR product bid in terms of minimum order size and activation time. The Latvian TSO offers various duration mFRR products with pricing based on the duration of the product activation (15 min. 30 min, 45 min or 60min).

2.3. Current practices in exchanging mFRR bids for balancing energy between Elering and Fingrid

The following table contains details on current practices in exchanging mFRR bids for balancing energy between Elering and Fingrid.

Table 2: Current practice of exchanging mFRR bids for balancing energy between Elering and Fingrid.

mFRR providers	Gate closure for submitting bids	Power	Price	Min order	Activation time
Elering	power and price; preceding day @16.30; amendments up to 45 minutes before the operating hour	tentative and according to free capacity of DC connections and operational situation in Estonia	conclusive	1MW (bid step)	within 10 minutes, exceptionally within 20 minutes
Fingrid	no bids prior to operational hour	according to free capacity of DC connections and operational situation in Finland	Tentative price provided prior to regulation, final price determined ex post at Nordic regulating power market for the hour in question	1 MW	within 15 minutes

Comments: each TSO propose a custom mFRR product bid in terms of gate closure for submitting bids, minimum order size and activation time. The price of the mFRR bid provided by Fingrid is not conclusive and is determined only ex post. Also the DC links ramping restriction of 30 MW/min must be followed when exchanging the mFRR energy between the synchronous areas.

2.4. Baltic current practices with mFRR bids for balancing energy (the bids inside the system)

Current practices of procurement and activation of mFRR bids for balancing energy inside power systems are not harmonised between Baltic power systems: there are differences in terms of bid volumes, firmness, order size and activation time.

2.4.1. Balancing bids inside the Estonian power system

The following table contains details on balancing bids inside the Estonian power system.

Table 3: Balancing bids inside the Estonian power system.

mFRR providers for Elering	Gate closure for submitting bids	Power and price conditions	Average bids for 2013	Min order	Activation time
EE Market Participants	power and price; preceding day @16.30; amendments up to 45 minutes before the operating hour	Power is tentative, price shall be conclusive	Average up-regulation bid: 106 MW Average down-regulation bid: 453 MW	1MW (bid step)	within 10 minutes, exceptionally within 20 minutes

2.4.2. Balancing bids inside the Latvian power system

The following table contains details on balancing bids inside the Latvian power system.

Table 4: Balancing bids inside the Latvian power system.

mFRR providers for AST	Gate closure for submitting bids	Power and price conditions	Average bids for 2013	Min order	Activation time
LV Market Participants	power and price; preceding day @17.00; amendments latest 15 minutes before operating hour	Power is tentative, price shall be conclusive: prices provided per regulation duration (min 15 minutes, min 30 minutes, etc.)	97 MW	10 MW (bid step)	Immediate

2.4.3. Balancing bids inside the Lithuanian power system

The following table contains details on balancing bids inside the Lithuanian power system.

Table 5: Balancing bids inside the Lithuanian power system.

mFRR providers for Litgrid	Gate closure for submitting bids	Power and price conditions	Average bids for 2013	Min order	Activation time
Participants of regulation auction	power and price; preceding day @17.00; amendments latest 30 minutes before operating hour	Power and, price are conclusive	Average up-regulation bid: 203 MW Average down-regulation bid: 265 MW	5MW with 1MW increase step	15minutes

3. Pricing principles for balancing energy

3.1. Overview about the pricing of balancing energy

The third chapter gives a general overview about the settlement issues, such as settlement rules and cost recovery schemes. Also the issue of transfer of obligation is covered.

The following summarizes the main differences of the pricing of balancing energy between the Nordic mFRR market and the Baltics:

- In the Nordics balancing energy pricing is based on marginal pricing by common Nordic balancing market rules: the prices of balancing power are determined on the basis of regulations carried out in the Nordic balancing power market. Both an up and down regulating prices are specified for each hour and for each bidding area. The price is set at the marginal price of the activated bids in the common merit order list. The up regulation price shall be the price of the most expensive up regulating bid used and the down regulation price shall be the cheapest down regulating bid used. The balancing bid price will be identical in all electricity spot market areas provided that no bottlenecks occur. The maximum price for regulation in the Nordic countries is 5000 EUR/MWh;

- In the Baltics, balancing energy pricing is based on "pay as bid" principle via bilateral agreements, and there is no common balancing market;
- There is no maximum price for mFRR energy in Estonia and Latvia. In Lithuania, the maximum price is 203 EUR/MWh.

3.2. Pricing and balancing market principles in Nordics

mFRR-market

Generators and consumers can place bids to increase production or lower consumption, but there are specific requirements for participation in the balancing market. The main requirement is that the offer can be activated in less than 15 minutes and that it can have duration of one hour. There are also rules regarding minimum size. The bids of regulation power reserves are combined in a common Nordic merit order list, and this is what is referred to as the Nordic regulation power market or common Nordic mFRR market.

The TSOs maintain a common merit order list of offered resources for manual up and down regulation. It is displayed for all TSOs through the Nordic Operational Information System (NOIS). Each TSO receives balancing bids from BSPs in its own country and place them on the common NOIS list where the TSOs cooperate in selecting offers. Thus, BSP never interact directly with NOIS. Offers are always submitted to the local TSO, which then places the offer in the NOIS list.

The TSOs act jointly as one single buyer in the Nordic balancing market and cooperate in selecting the offers to use. In practice, Statnett and Svenska Kraftnät monitor the system and decide which offers to select. Whenever an offer is selected, responsibility for ordering the BSP to activate the service is delegated to the local TSO.

As far as possible, offers are selected according to merit order. The cheapest offers are selected first, unless congestion is present. When there is a shortage of electricity the TSOs will buy electricity for up-regulation (increased production or decrease consumption) having the lowest asking price. When there is a surplus of electricity, the TSOs will buy down-regulation by selecting offers to decrease production or increase consumption.

Congestions are generally handled in the day ahead market though market splitting (different price areas in case of congestions). If there are internal congestions within these areas, these handled by the TSOs. Internal congestions normally require the choice of bids which are located in the relevant part of the grid.

Pricing

Marginal pricing is used when the BSPs are remunerated for their services. When the delivery hour has passed, the price of the most expensive up regulation offer that has been activated in the balancing market becomes the so-called up regulating price, which is the price paid to all activated up regulation offers. Similarly, the lowest activated down regulation bid defines the down regulation price, which is paid to all activated down regulation offers. This marginal price mechanism is used to stimulate BSPs to submit reasonable offers.

The balancing price for an hour depends on whether the accepted balancing offers were used to handle a shortage or surplus of electricity (up or down regulation). If there were both up and down balancing during the hour, the dominating direction determines whether it is an up or down regulation hour.

When there is no congestion, the regulating price will be the same for the whole region. In the presence of congestion, regulation bids may be picked outside the merit order since the balancing must be done based on geographical factors. In this case, the region will be split into smaller areas and there will be different regulating price for each area. However, bids used for special regulation (such as countertrading) are not allowed to influence the regulating price for the hour. Furthermore, when a BSP is paid for balancing bids that are used to handle congestion, the BSP receives what it asked for (pay-as-bid), unless the final marginal price for the hour turns out to better, in which case the BSP receives the marginal price instead.

The prices of balancing power are publicised primarily on Nord Pool Spot's website no later than two hours after the hour in question.

4. Imbalance energy settlement and pricing principles within Baltic and Nordic countries

4.1. Introduction

This chapter gives an overview of imbalance energy settlement and pricing principles within the Baltic and Nordic countries. Imbalances are deviations between generation, consumption and commercial transactions of a Balance Responsible Party (BRP) within a given Imbalance Settlement Period. Imbalance settlement is a financial settlement mechanism aiming at charging or paying Balance Responsible Parties for their Imbalances. Imbalance settlement price is calculated in each settlement period for the negative and the positive imbalance. Negative imbalance is defined as the one in which the real generation is lower than scheduled or real consumption is greater than scheduled. Positive imbalance is defined as the one in which the real generation is greater than scheduled or real consumption is lower than scheduled.

Detailed tables for comparison can be found in Annex 2.

4.2. Current practices with imbalance settlement and pricing in the Baltics

Imbalance settlement differs between Baltic countries in many respects. There is a different number of balance portfolios and also the imbalance pricing principles are not harmonised. The summarised imbalance settlement and pricing principles per country is described as follows. Baltic TSOs performs area balance control, the area control error (ACE) for Estonia is ±30MWh/h; for Latvia ±30MWh/h; and for Lithuania ±50MWh/h. The imbalance electricity prices are mostly based on the costs of the power system's imbalances (ACE).

4.2.1. The imbalance settlement and price methodology in Estonia

In Estonia, there is only one balance for Balance Providers. The balance plan includes production, consumption and consolidated data of supplies from the power exchange.

The Balance Provider shall submit the Balance Plans to the TSO as follows:

- The final daily Balance Plan for the next day (D-1) shall be submitted by 16.20 each day with the data presented by trading period;
- The Balance Provider shall submit the corrections to the Balance Plan to the TSO as soon as the power exchange operator has confirmed the transaction regardless of the trading period for which the transaction was made, and no later than fifty (50) minutes prior to the corresponding trading period;
- The Balance Provider shall submit to the TSO the Balance Plan in which the fixed supplies always match those of the counter-parties. According to the balance agreement and the law, the forecasted and/or systematic purchasing or selling of imbalance electricity is not allowed.

The TSO shall submit to the Balance Provider a balance report on each trading period. The initial balance settlement shall be carried out each month as follows:

- the metering data from each metering point is made available to the parties in the Data Warehouse;
- The aggregated report of the total sum of measured supplies in the Balance Provider's Balance Area shall be sent to the parties by the 10th day of each month;
- the TSO shall submit to the Balance Provider no later than the 15th day of each month the initial balance report for the preceding month;
- To settle the final balance, the TSO shall submit to the Balance Provider a final balance report as soon as possible after receiving the information specified but no later than three (3) months after the end of the month.

Elering shall set the price of imbalance electricity such that the price enables the TSO to:

- cover the costs of balancing energy (mFRR);
- cover the costs of cross-border open supply;
- cover the costs of imbalance electricity sold and purchased with the balance providers;
- cover the costs of imbalance settlement;
- the selling and purchasing of imbalance electricity shall be cost-based: the commercial income of the TSO for each financial year shall be equal to its commercial expenses;
- when setting the price of imbalance electricity, the TSO may accord preference to market participants whose balance deviation during a given trading period is converse to the balance deviation of the system as a whole during the same trading period, as opposed to market participants whose balance deviation during the same trading period is in the same direction as the balance deviation of the system as a whole;
- Balancing deliveries for cross-border countertrades, and also balancing deliveries as system services for other TSOs, are not included in the imbalance price calculation.

Elering shall publish on its website the purchase and selling prices of imbalance electricity by trading period after two working days by 16.30. The reference price for calculating the imbalance prices is the cross-border open supply tariffs sent by the Latvian market participant:

- the final open supply price (open supply price = ACE = balance area control error) is calculated D+1 taking into account the imbalances of the Estonian and Latvian electricity systems;
- The Latvian market participant sends open supply tariffs D-2 (4 tariffs as input for final calculation based on weighted average price: if Estonian system imbalance is in the opposite direction compared to Latvian system imbalance, the prices are more beneficial).

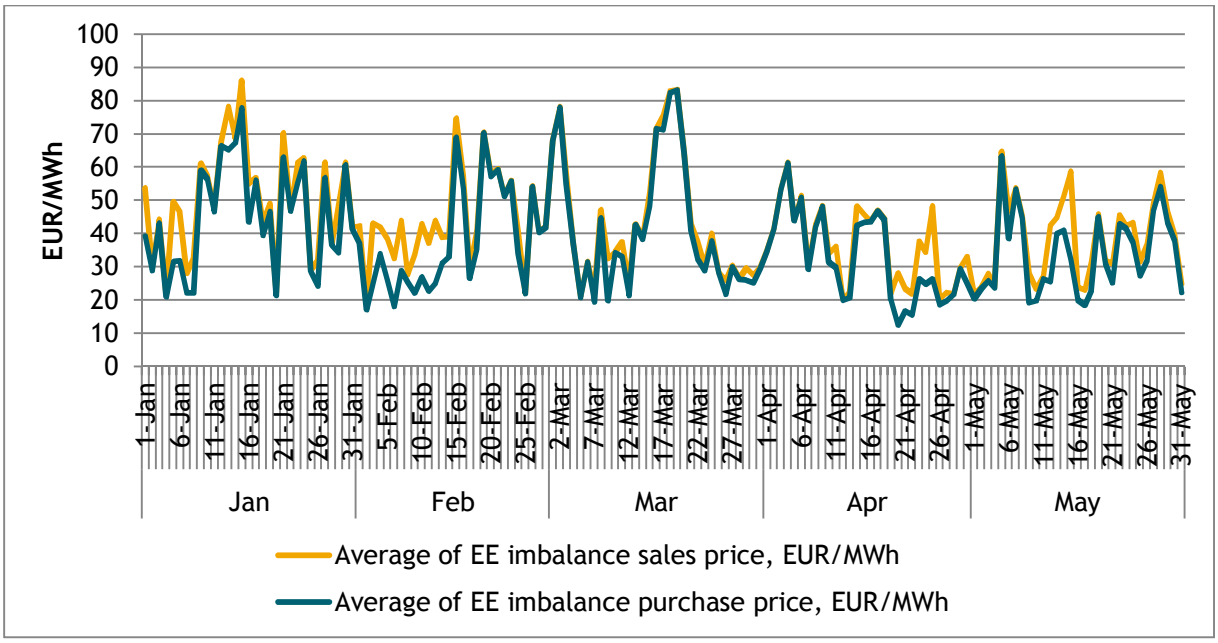

Figure 2: Daily-Average Imbalance Prices in Estonia.

*The main reference for imbalance price is the direction of system total imbalance: if the system totally is importing the imbalance electricity from Latvia, the open supply price for EE is expensive, if the system totally is exporting the imbalance electricity to Latvia, the open supply price for EE is similar to down-regulation price as there is a surplus in the system. The spread of sales and purchase price shall cover the costs for imbalance settlement.

4.2.2. The imbalance settlement and price methodology in Latvia

- Imbalance of the Latvian power system is calculated by taking into account planned generation and consumption of the system and actual import and export data of the system, together with activated upward or downward balancing energy.
- Imbalance of each Balance Responsible Party (BRP) is calculated as the difference of planned and metered data.
- There is one Imbalance Portfolio for each BRP – combined generation and consumption volume.
- Imbalance price is determined to cover all the expenses of the system operator, which are caused by actions to keep the system in balance. The price is calculated based on Average Area Control Error (ACE, or system imbalance) Price. Dual pricing system is used – varied price for positive imbalances and negative imbalances. A coefficient of 0.97 is applied for the positive imbalance and 1.03 for the negative imbalance.
- Imbalance Settlement is carried out for each hour and the data is published in the end of the month with a complaint period of 8 weeks.

- Price for the Latvian imbalance energy for BRPs operating in Latvia is the weighted average price of Average Area Control Error (ACE, or system imbalance) energy from Open Balance Provider, activated balancing and emergency reserve bids used for balancing.

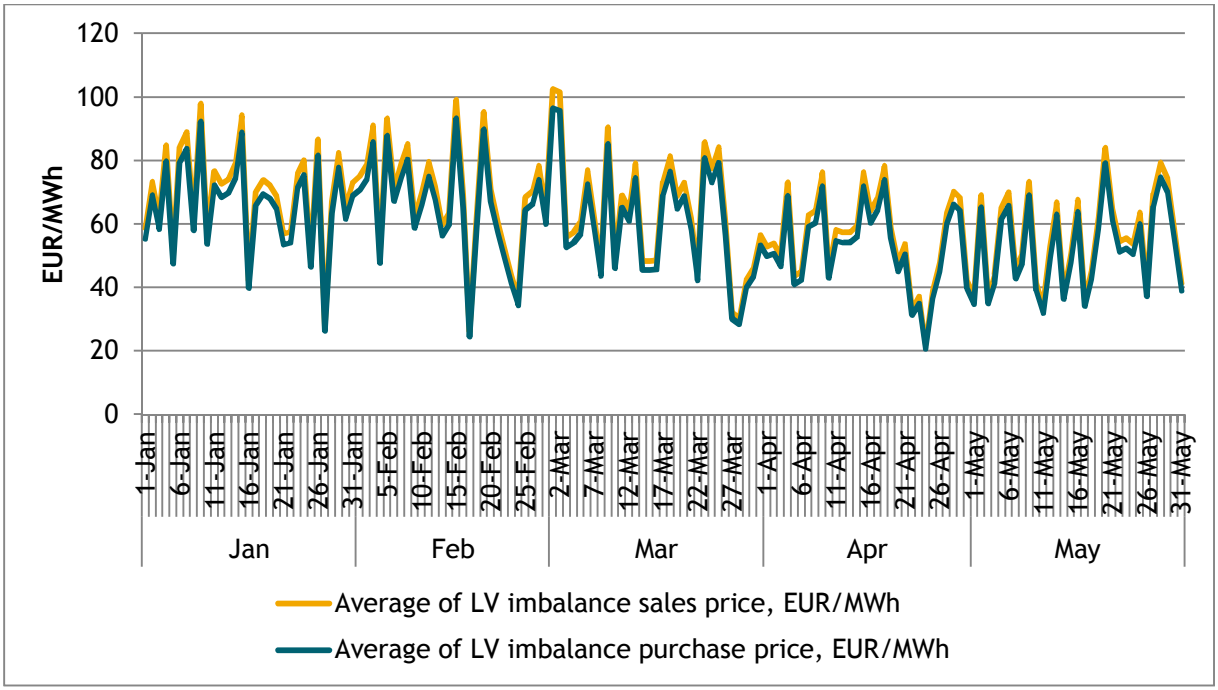

Figure 3: Daily-Average Imbalance Prices in Latvia.

4.2.3. The imbalance settlement and price methodology in Lithuania

- There are three imbalance portfolios – generation, consumption and cross-border trade.
- Imbalance energy for the power system is calculated as the difference between planned import and export data of the system together with activated upward or downward balancing energy within the system and actual import export metering data.
- Balance Provider shall submit to the TSO the Balance Plan in which there must be balance between production and purchases vs. consumption and selling. According to the standard balance agreements between TSO and BRPs, the forecasted and/or systematic purchases or sales of imbalance electricity is not allowed.
- Imbalance of each Balance Responsible Party (BRP) is calculated comparing its planned and metered data for generation and consumption balances, and actual data for cross-border trade.
- Dual pricing system is used to set Imbalance prices. Imbalance price for Aggrevating system imbalance is calculated based on weighted average price of Area Control Error (ACE, or system imbalance) and activated balancing energy bids while reducing system imbalance is calculated based

on the day-ahead market price. Additionally, coefficient of 1.02 is applied for the imbalance purchase price and 0.98 for imbalance selling price.

- Imbalance Settlement is carried out for each Settlement period of the month, but no later than the 8th working day of the next month.

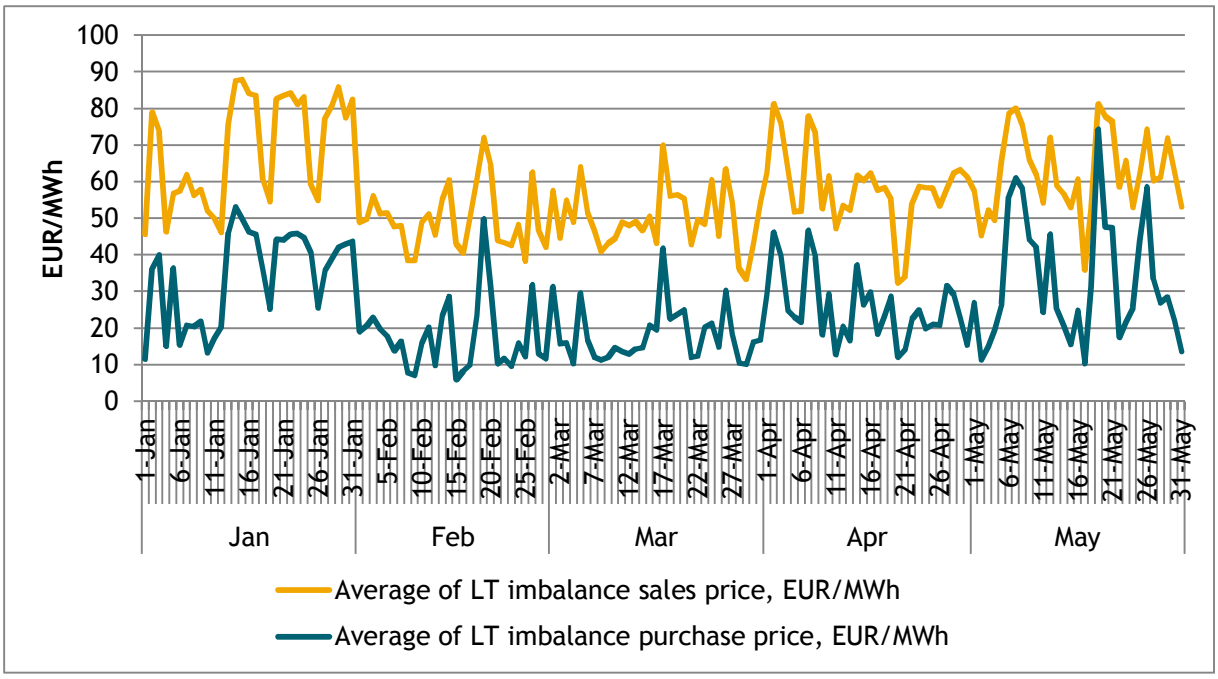

Figure 4: Daily-Average Imbalance Prices in Lithuania.

4.3. Comparison of imbalance settlement and pricing principles in the Baltics

In all Baltic countries the imbalance settlement is carried out by TSOs for Balance Responsible Parties for every hour, but there is a different approach in methodology, mainly in terms of the number of imbalance portfolios and the calculation of imbalance prices.

The model for pricing of imbalances is a two-price model in all countries. The main component of imbalance price calculated by AST and Elering is the system open supply price provided by the system's Open Balance Provider. If there have been balancing deliveries, the cost of balancing is also included in the imbalance price calculation. Elering's and AST's detailed methodologies for imbalance price calculation are different, but for both there is no direct relation between imbalance prices and power exchange prices.

For calculating the imbalance prices, Litgrid, in addition to the system open supply prices and balancing prices also uses the Elspot prices.

The following two tables contain details on main differences in imbalance settlement and pricing principles and similarities within Baltics.

Table 6: The main differences in imbalance settlement and pricing principles.

Differences between the countries	Estonia	Latvia	Lithuania
Number of imbalances	Single balance: Total = Production - Consumption	Single balance: Total = Production - Consumption	Three balances: -Production -Consumption -Cross-border trade
Major cost-based differences	Cost based methodology.	Cost based methodology.	
Imbalance price methodology: main component for price	Aggravating imbalance= weighted average price (ACE + balancing) + marginal; Reducing imbalance= weighted average price (ACE + balancing) – marginal.	Weighted average control energy price with coefficients	Aggravating imbalance= weighted average control energy price x coefficient; Reducing imbalance= day ahead market price x coefficient
Imbalance price publication	D+2	15th date of the next month	8th working day of the next month
Number of balance providers	6 + 1 (TSO portfolio for grid losses)	8	19 Active
Open Balance Provider for System imbalance (ACE)	Latvian market participant	Latvian market participant	Lithuanian market participant
Price methodology for system open supply price (ACE)	2 tariffs for sale and purchase: If Estonian system imbalance is in the opposite direction compared to Latvian system imbalance, the prices are more beneficial.	2 tariffs – for sale and for purchase	Price is divided into energy volume steps
Price methodology for balancing	According to offers, pay as bid. Balancing bids are	According to offers, pay as bid.	According to offers, pay as bid.

deliveries	more expensive than Elspot prices.		
Data exchange format	Entso–e xml format	Excel documents	Excel documents
Measured deliveries for BP balance report	Aggregated report from Data Warehouse	Data from network operators	Data from network operators
IT solution for settlement	Balance Management Software (BMS)	Custom IT solution	No IT solution
IT solution for balancing information	Balance Management Software (BMS)	Custom IT solution	No IT solution
IT solution for measured data per metering points inside the system	Data Warehouse	Custom IT solution	No IT solution
Initial balance report for BRP	M + 1 (by 15th)	Settlement data must be finalized no later than 10th working day of the next month	8th working day of the next month
Correction period for final balance report for BRP	3 months	2 month	No correction period
Guarantees for BRP	Permanent guarantee 31,955 EUR + variable guarantee	Permanent guarantee 31,000 EUR + variable guarantee	Guarantee is calculated on a daily basis: Not paid amount for imbalance of previous month plus preliminary payment for current month multiplied by 2. Minimal guarantee 100kEUR
Balance obligation for RES	BRP	BRP	TSO
Balance agreement standard terms and conditions	Approved by Competition Authority	Approved by company	Approved by company

Table 7: Similarities between countries

The same between the countries	Estonia	Latvia	Lithuania
Trade via Elspot and Elbas	Nord Pool Spot	Nord Pool Spot	Nord Pool Spot
Balance report	Monthly based	Monthly based	Monthly based
Imbalance calculation	Measured – fixed – balancing	Measured – fixed – balancing	Measured – fixed – balancing
Imbalance pricing model	Two-price	Two-price	Two-price

The imbalance electricity sales and purchase prices are based on the power system's imbalance (ACE). In Estonia and Latvia, an imbalance surplus in a trading period lowers the imbalance price and an imbalance deficit in a trading period increases the price. Therefore, balance providers, operating in the Estonian and Latvian power system, are subject to high risk, which could result in a significant gain, as well as a heavy loss – all of which depend on whether their respective country's system imbalance is positive or negative. In Lithuania, there is a significant spread between the imbalance sales and purchase prices. The price of imbalance electricity purchased by the TSO is lower than the power exchange price, creating a high difference between purchase and sales prices.

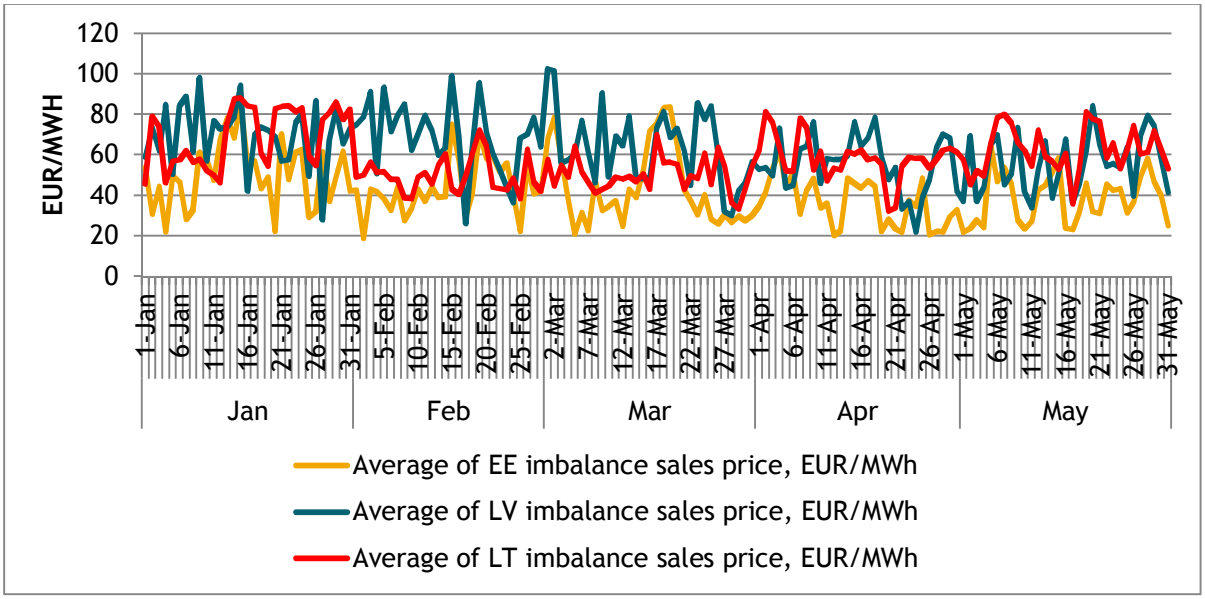

Figure 5: Daily-Average Imbalance Sales Prices in the Baltics (from TSO point of view).

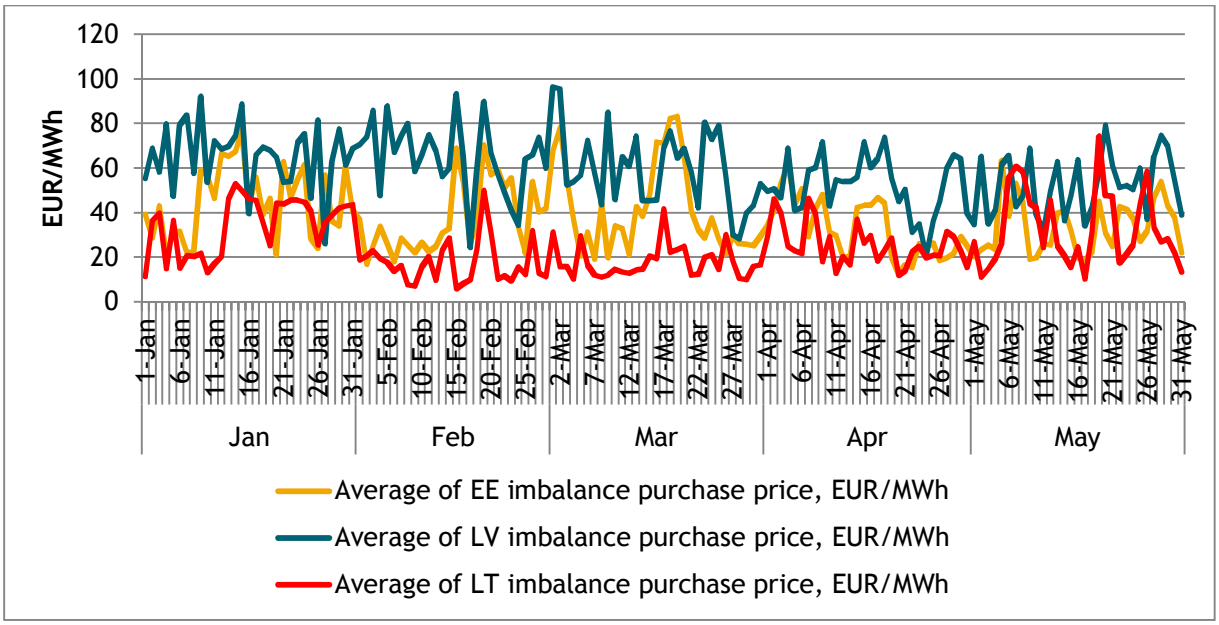

Figure 6: Daily-Average Imbalance Purchases Prices in the Baltics (from TSO point of view).

4.4. Identification of the imbalance volumes to take into account for Baltic common balancing market development

Estonia

The daily average imbalances from balance provider's portfolios and the activated balance deliveries have been as follows:

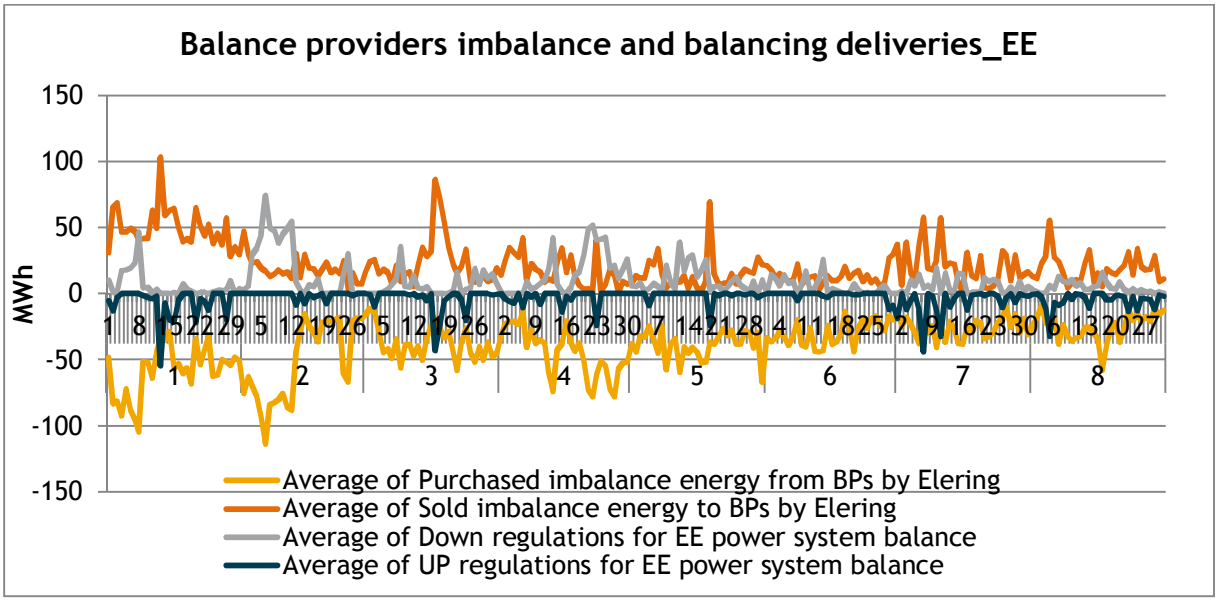

Figure 7: The daily average BP's imbalances and balancing deliveries in Estonia.

As shown in the graph above, the BP‘s imbalances were extremely volatile in January. This was caused by changes in the BP‘s contracting volumes as a large number of consumers had entered into contract with a new provider. From February onwards, the imbalances of BP‘s have remained closer to balance. The positive trend is mainly caused by ongoing improvements in the BPs‘ data exchange quality, thus resulting in a better forecasting accuracy.

The occurrence of large scale imbalances were mainly caused as a result of unforeseeable outages in the power plant units during the operational hour. Afterwards, the BP would offset the deviation, which resulted from the outage by trading on the intra-day Elbas market.

In the near future, the primary cause for extensive imbalance deviations shall be due to outages in power plant units and because of unpredictable wind conditions. As of September 2014 the total installed wind generation capacity in Estonia is 317 MW; however, it is estimated that by the end of 2018, total wind power installations would add up to 667 MW, thus leaving wind energy with an even greater role in causing substantial imbalance fluctuations in the BPs’ portfolios.

Latvia

BRP are responsible for planning their balance portfolios and receives financial costs in case the actual consumption deviates from planned values. During scheduling process BRPs are obliged to provide balanced position, therefore imbalance volumes are caused by forecast errors. BRP‘s imbalances are not high and more significant dependency on weather conditions.

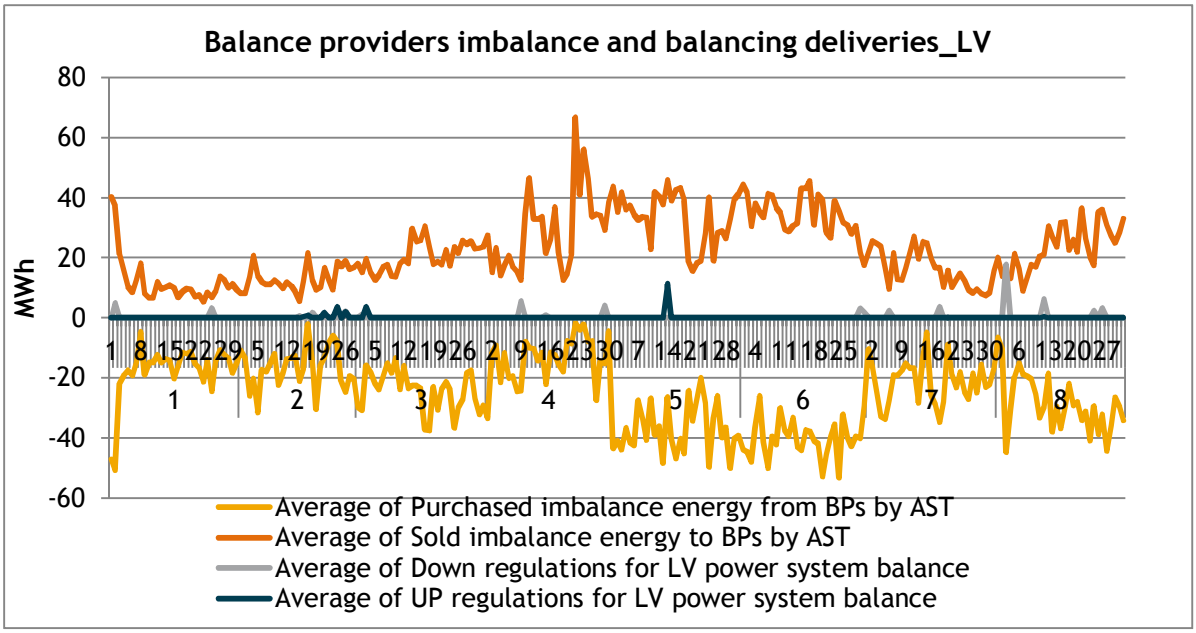

Figure 8: The daily average BP’s imbalances and balancing deliveries in Latvia.

In the future there are no predictable conditions that may substantially affect changes in imbalance volumes.

Lithuania

The figure below depicts average volumes of imbalances by balance providers portfolios and the activated balance deliveries for year 2014 in Lithuania:

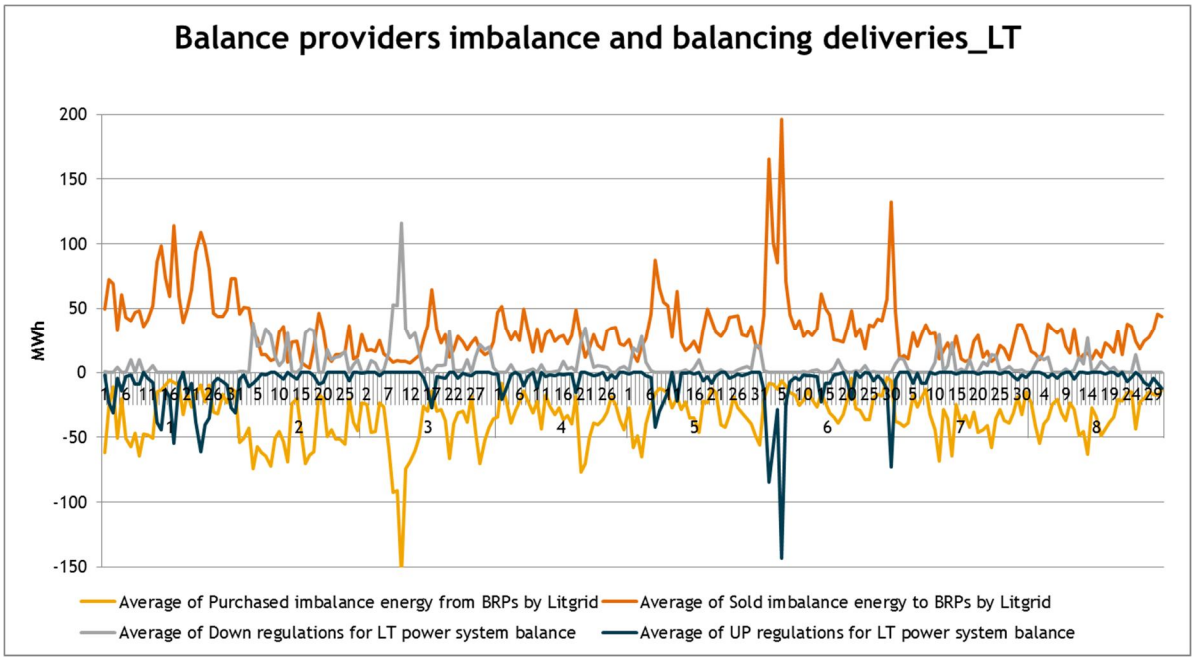

Figure 9: The daily average BP's imbalances and balancing deliveries in Lithuania.

BRP are responsible for planning their balance portfolios and receives financial costs in case the actual generation or consumption deviates from planned values. During scheduling process BRPs are obliged to provide balanced position, therefore imbalance volumes are caused by forecast errors or emergency outages of generation units.

As shown in the graph above, the BRP's imbalances were higher in January due to relatively higher consumption and more significant dependency on weather conditions. Also during spring period, the BRP's positive imbalance volumes were higher mainly due to higher utilization of wind generation and not typical days between public holidays. High hourly imbalance also recorded in the beginning of summer when transfer capacities were limited.

In the near future, the primary cause for extensive imbalance deviations shall be due to outages in of big generation units and due to increase of renewable generation volume volatility. As the total installed wind generation capacity in Lithuania is 282 MW in 2014, it is estimated that by the end of 2016, total wind power installations would add up to 500 MW. Also significant part of imbalances

is caused by solar generation that has installed capacity of 68MW in 2014, therefore during summer periods variable weather conditions can significantly impact total imbalance deviations in Lithuania.

4.5. Current practices with Imbalance Settlement and Pricing in Nordics

Description of the common Nordic balance model:

The common Nordic balance service model was introduced at the beginning of 2009, when all the main principles were harmonised between the Nordic countries.

Main elements of the common model are:

- two balances: production and consumption balance;
- two-price model for production balance and one-price model for consumption balance;
- marginal pricing;
- binding production plans;
- common cost structure relating to balance service.

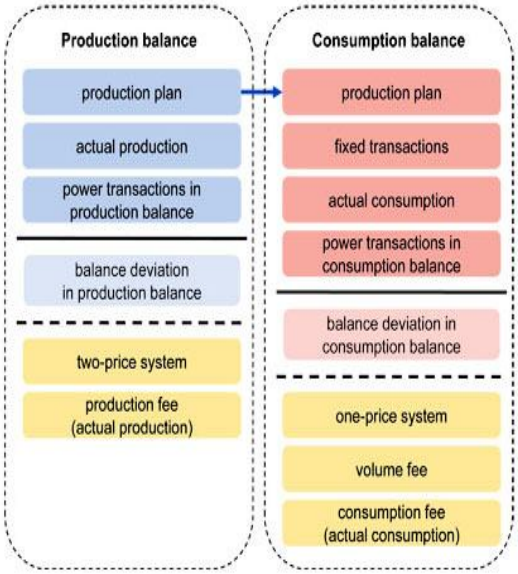

Figure 10: Model of two balances

Model of two balances:

In the model of two balances, generation is handled in one balance, and purchases, sales and consumption of electricity in another. Moreover, the production plan given from the production balance before the beginning of the specific hour is processed in the consumption balance in the balance settlement procedure.

Production balance

The production balance is composed of a balance responsible party's total production plan and actual production.

The TSO sums up the production plans reported by a balance responsible party into the balance responsible party's total production plan. A production plan always gives a positive figure.

A balance deviation in the production balance arises when there is a difference between the actual production and the production plan:

- When the actual production of a balance responsible party is less than the production plan, there is a deficit in the production balance. To cover the deficit the balance responsible party shall purchase imbalance power from the TSO.
- When the balance responsible party produces more electricity than what it has planned to produce, there is a surplus in the production balance. In this case the balance responsible party sells imbalance power to the TSO in order to take care of the surplus.

Consumption balance

A balance responsible party's consumption balance is composed of the balance responsible party's total production plan, fixed transactions, and actual consumption.

The balance deviation in the consumption balance arises when there is a difference between the actual consumption and electricity purchases (fixed transactions, production plan).

- When the balance responsible party consumes more electricity than what it has planned to consume, there is a deficit in the consumption balance. The balance responsible party purchases imbalance power from the TSO in order to cover the deficit.
- When the balance responsible party consumes less electricity than what it has planned to consume, there is a surplus in the consumption balance, and the balance responsible party sells imbalance power to the TSO in order to take care of the surplus.

Two-price and one-price system:

A different price model is applied to the balance deviation existing in the production and consumption balances, i.e. to balance power.

A two-price system is applied to the balance deviation in the production balance, and a one-price system is applied to the balance deviation in the consumption balance.

In the two-price system, separate prices are calculated for the purchase and sales of imbalance power.

Sales price of imbalance power: The price of imbalance power in the production balance sold by the TSO to the balance responsible party is the up-regulating price of the hour. If no up-regulation has been carried out, or if the hour has

been defined as a down-regulating hour, the Elspot area price is used as the sales price of imbalance power in the production balance.

Purchase price of imbalance power: The price of imbalance power in the production balance purchased by the TSO from the balance responsible party is the down-regulating price of the hour. If no down-regulation has been carried out or if the hour has been defined as an up-regulating hour, the Elspot area price is used as the purchase price of imbalance power in the production balance.

Two-price system is applied to the balance deviation in the production balance, i.e. separate prices are calculated for the purchase and sales price of imbalance power. Imbalance power in the production balance is not subject to a volume fee.

In the one-price system, the purchase and sales prices of imbalance power are identical.

During an up-regulating hour, the price of imbalance power is the up-regulating price, and during a down-regulating hour, the price of imbalance power is the down-regulating price. If no regulations have been carried out during an hour, the price of imbalance power is the Elspot area price.

One-price system is applied to imbalance power in the consumption balance, i.e. the purchase and sales prices of imbalance power are identical. Imbalance power in the consumption balance is subject to a volume fee.

The figure below describes the various price systems.

		2-price			1-price			
		Up-regulating hour	No regulations	Down-regulating hour	Up-regulating hour	No regulations	Down-regulating hour	
	Up-regulating price	100	50	50	100	50	50	€/MWh
	Spot price	50	50	50	50	50	50	"
	Down-regulating price	50	50	20	50	50	20	"
Balance provider's	purchase price for balance power	100	50	50	100	50	20	"
	sales price for balance power	50	50	20	100	50	20	"

Figure 11: Various price systems

Reserve costs inclusion in balance service:

One of the issues in the Nordic harmonisation of balance service was to standardise the cost basis related to balance service. The transmission TSO's reserve costs account for the highest cost item in balance service. Here, reserves refer to those reserves, which the TSO needs to maintain the frequency and system security of the nation-wide transmission grid.

The costs of various types of reserves are allocated, using the matching principle, both to balance service and to other TSO services – primarily grid service – so that the costs of frequency-controlled normal operation reserve belong to balance service, and the disturbance reserves (frequency-controlled disturbance reserve and fast disturbance reserve) belong both to balance service and other services. The principle of dividing the costs of disturbance reserves is the same for both reserves.

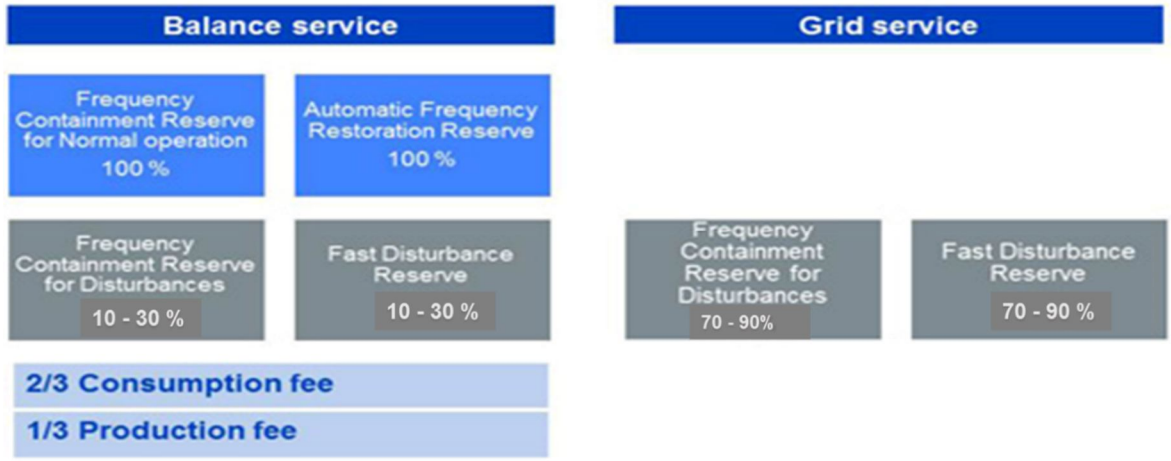

Figure 12: The principle of dividing the costs of reserves

An example of balance service fees in Finland:

Balance service fees	**Fees from 1 August 2014**
Fixed monthly fee	200 €
Actual production	0,150 €/MWh
Actual consumption	0,250 €/MWh
Volume fee for imbalance power in the consumption balance	0,5 €/MWh

5. TSO-TSO settlement rules

5.1. Current practices of TSO-TSO settlement rules in Baltics

- Russian SO performs centralized frequency control.
- Baltic TSOs perform area balance control, the area control error (ACE) shall not exceed for Estonia ±30MWh/h; for Latvia ±30MWh/h; and for Lithuania ±50MWh/h;
- The market participants in Latvia and Lithuania are Open balance providers of imbalance energy for the Baltic TSOs:
    - The Open balance provider for the Estonian system is a Latvian market participant;
    - The Open balance provider for the Latvian system is a Lithuanian market participant;
    - The Latvian market participant has an agreement with the Lithuanian market participant to sell and purchase the imbalance energy from Estonia and Latvia to Lithuania;
    - The Open balance provider for the Lithuanian system is a Lithuanian market participant.

5.1.1. TSO-TSO settlement practices between Baltic TSOs.

The following table contains comparison of TSO-TSO settlement practices in Baltics.

Table 8: TSO-TSO settlement practices between Baltic TSOs

	Elering- AST	Elering -Litgrid	AST-Litgrid
Cross-border flows	Daily – hourly measurements at CB power lines' balance points	N/A	Daily – hourly measurements at CB power lines' balance points
mFRR	Volume and price confirmed on the following business day. Monthly – total volume and cost confirmed at beginning of month, acts signed and invoices issued.	Volume and price confirmed on the following business day. Monthly – total volume and cost confirmed at beginning of month, acts signed and invoices issued.	Volume and price confirmed on the following business day. Monthly – total volume and cost confirmed at beginning of month, acts signed and invoices issued.

Emergency reserves	Volume and price confirmed on the following business day. Monthly – total volume and cost confirmed at beginning of month, acts signed and invoices issued.	Volume and price confirmed on the following business day. Monthly – total volume and cost confirmed at beginning of month, acts signed and invoices issued.	Volume and price confirmed on the following business day. Monthly – total volume and cost confirmed at beginning of month, acts signed and invoices issued.
Counter-trades	Daily – Volume and cost/income confirmed on the following business day. Monthly – total volume and cost/income confirmed at beginning of month, act signed and invoices issued.	N/A	N/A
CB imbalance	Daily for previous period: between Latvian market participant and Elering. Monthly – volume confirmed at beginning of month.	N/A	N/A

5.1.2. Imbalance netting between the Baltic TSOs

Currently, there is no imbalance netting between the Baltic TSOs according to imbalance netting definitions. According to system open supply agreement between Elering and the Latvian market participant, the imbalances from Estonia and Latvia systems are taken into account as follows:

- If the imbalances from EE and LV systems are in the opposite directions, the imbalance energy is purchased and sold by more beneficial tariffs;
- If the imbalances from EE and LV systems are in the same directions, the imbalance energy is purchased and selled by quite expensive tariffs;
- there is no direct relation between imbalance prices and power exchange prices.

5.2. Current practices of TSO-TSO settlement rules in Nordics

The Nordic synchronous power systems are balanced as one single area, Load Frequency Control (LFC) block, and activations are done according to frequency of the whole synchronous area. The Area Control Error (ACE) of a single TSO is not used as a control criterion in real-time. A "free cross-border flow" of balancing/imbalance energy is allowed between TSOs. Balancing energy is activated from the Common Merit Order List (CMOL) in price order. Marginal pricing is used and the highest (up regulation) or lowest (down regulation) priced activated bid defines the price also for imbalance energy.

Imbalance energy and balancing energy at TSO level are not separated and the deviation energy between total measured flow and trade schedules between TSOs is settled for price defined by CMOL. When both all balancing energy and imbalances are settled for the same common price, the result is financially neutral.

Imbalance power between the TSOs is calculated during settlement as the difference between the measured exchange of power and the sum of all forms of agreed exchange.

Imbalance power between the TSOs within the synchronous system is priced at the average of the regulation prices in these subsystems. For ”no regulation hour” the price is an average of Elspot prices.

It should be pointed out that it is planned to analyse the TSO-TSO settlement between Nordic TSOs and that the TSO-TSO settlement rules for exchange of different products of balancing energy may change.

5.2.1. Imbalance netting between the Nordic TSOs

Imbalance netting is used between the Nordic TSOs. Western Denmark is not included in imbalance netting but use area control error (ACE) as control criterion in real time. Imbalance netting is not applied at the external borders of the Nordic system.

5.3. Current practices of TSO-TSO settlement between the Nordics and Baltics (between Fingrid and Elering)

The interconnectors operating and reporting obligation shifts between Elering and Fingrid every six months. The party in charge is responsible for reporting and invoicing.

The following table contains details on current practices of TSO-TSO settlement between the Nordics and Baltics.

Table 9: Current practices of TSO-TSO settlement between the Nordics and Baltics (between Fingrid and Elering)

Data exchange	• Daily – measurements at CB power lines' exchanged automatically. • Daily – AFC data exchanged automatically • mFRR volume and price confirmed on the following business day. • Countertrades – weekly total volume and cost/income for previous week.
Settlement	• Weekly reports and invoicing by reporting party only. • Imbalance is determined by taking account the fixed trades, measurements in the settlement points (middle of the interconnectors), mFRR, AFC, countertrades, operating mistakes. • The hourly imbalance energy is priced according to an average value of the imbalance energy prices in Finland and Estonia in that specific hour.

6. The limitations and possibilities to develop the exchange of mFRR between Nordic and Baltic TSOs based on current balancing set up

6.1. Introduction

This chapter gives an overview about the limitations and possibilities to develop the exchange of mFRR between Nordic and Baltic TSOs based on the current balancing set up. For several years there has been an ongoing exchange of balancing energy between Estonia and Finland. The other Baltic and Nordic countries have not been part of this arrangement. The exchange procedure between two TSOs has been developed and tuned during this timeframe. One possibility to develop the exchange of mFRR between the Nordic and Baltic TSOs, is to base it on the Estonian and Finnish experience.

6.2. Possibilities

- The exchange of balancing energy based on the current mFRR products could be theoretically possible (as one can see from the Estonian and Finnish experience). Product activation time up to 15 minutes and hourly resolution (except in case of Latvia) should be technically sufficient.

- Possible option could be that in addition to Estonian bids exchange with Finland, also the bids from Latvia and Lithuania could be incorporated.
- Pricing in the Nordics and the Baltics is different, but this can be handled as it is handled today between Estonia and Finland – bid from other TSO is activated on the basis of price (in case there are no technical limitations), but paid in accordance with the local settlement arrangements (marginal price in case of Nordic bids and pay as bid in case of Baltic bids).
- After the commissioning of the NordBalt DC link between Sweden and Lithuania the balancing energy exchange similar to that of between Estonia and Finland could also be arranged between Lithuania and Sweden.

6.3. Limitations

- Nordic bids will not be part of merit orders put together by the Baltic TSOs, since these bids are not known for Baltic TSOs in advance. The possibilities and conditions to use these bids will become clear during operational hour after the inquiry from respective control room.
- The practical arrangements for balancing energy exchange might be an issue. Some of the information (for instance about the expected prices of the bids in Finland) has to be exchanged by phone. Since balancing energy is transmitted through DC links, the control rooms of TSOs who operate the DC links will have an additional work flow and the need for additional resources.
- Latvian bids have different time resolution than one hour.
- There are different requirements in mFRR activation in the Baltics. This creates obstacles in mFRR exchange with the Nordic countries.
- The Finnish bids are available for Elering, but the common Nordic mFFR-bids only in limited scale. This is because of contractual reasons, lack of Nordic-Baltic harmonisation and technical reasons.
- Frequent congestion at the Estonian-Latvian cross-border could reduce the possibilities to exchange balancing energy from Finland/Nordics to Latvia/Lithuania.
- There is no common balancing market in the Baltics.
- There is no TSO-TSO model for imbalance energy exchange in Baltic.

6.4. Steps to increase compatibility of the Baltic mFRR markets with the Nordics

The lack of harmonisation 1) between the Baltic mFRR-markets and 2) between the Baltics and Nordics are essential obstacles, which hinder the efficient co-operation with mFRR between the Nordic and Baltic power systems. The following changes would increase the compatibility of the Baltic mFRR markets with the Nordic mFRR market.

- The Baltic TSOs' should take more clear role in balancing power systems in Baltics, i.e. to the extent it is practically achievable so that the Latvian and Lithuanian market participants should be excluded from being open balancing providers to the TSOs;
- Common Baltic balancing energy (mFRR) market should be created;
- Balancing power pricing should be based on marginal pricing;
- mFRR product definition shall be harmonised between Baltic TSOs and towards Nordic mFRR product;
- Balancing market in the Baltics should be based on principles and details (imbalance prices formation, calculation of imbalances, etc.) which are clear and transparent;
- The imbalance pricing design in the Baltic countries shall be harmonised – according to NC, all TSOs shall harmonise the main features for imbalance calculation and imbalance pricing;
- Balancing principles and pricing shall lead that imbalance prices should be less advantageous to BRP than day-ahead and (in general) intraday market prices (according to NC requirements).

It should be noted that fulfilling all of the proposed changes are not preconditions for Baltic - Nordic cooperation. The Baltic - Nordic cooperation can take part even if not all of the proposed changes regarding common Baltic mFRR market are made within the Baltics.

Work Package II: Imbalance Settlement

This work package contains an analysis of the common Baltic imbalance settlement perspectives.

1. *Possibilities for imbalance netting internally in the Baltic system and towards neighbouring systems.*

2. *Proposal for TSO-TSO imbalance settlement in the Baltic system and comparison to the new Nordic TSO-TSO balance settlement system (eSett). Proposals for the actions needed to harmonise imbalance pricing and settlement principles within the Baltics and towards Nordic system principles.*

7. The common imbalance settlement perspectives

7.1. Introduction

This work package shall contain an analysis of the Baltic's and Nordic's common imbalance settlement perspectives.

1. Possibilities for imbalance netting internally in the Baltic system and towards neighbouring systems.
2. Proposal for TSO-TSO imbalance settlement in the Baltic system and comparison to the new Nordic TSO-TSO balance settlement system (eSett). Proposals for the actions needed to harmonise imbalance pricing and settlement principles within Baltics and towards Nordic system principles.

7.2. Possibilities for imbalance netting internally in the Baltic system and towards neighbouring systems

This chapter provides an overview of the possibilities for imbalance netting internally in the Baltic system and towards neighbouring systems based on the current practices of power systems balancing within Baltic States.

7.2.1. General overview of the current situation in the Baltics.

Currently, the Open balance providers that supply imbalance energy for the Baltic TSOs are market participants: Latvian market participant for Elering and AST, Lithuanian market participant for Litgrid

The following drawbacks of the current setup are identified:

- Lack of imbalance price transparency;
- Not equal rights for all parties – current Open balance providers in Latvia and Lithuania might gain an advantage over other market participants;
- Baltic TSOs have higher balancing costs, as current open balance providers gain from the non-existent imbalance netting between the Baltic power systems;
- Obstacles to integrate the Baltic balancing markets.

7.2.2. Target model for the Baltic power systems imbalance netting

Considering the drawbacks of the current balancing setup within the Baltic power systems, it is reasonable that:

- Harmonization of the balance management system principles shall be introduced (planning, measurements, etc.);

- Imbalance netting between the Baltic TSOs shall be applied;
- Baltic TSOs shall apply common methodology for imbalance calculation and netting within Baltic power systems;
- Not netted Baltic imbalances shall be traded with one nominated Baltic TSO which in turn shall trade the total Baltic not netted imbalance with an Open balance provider.

Pursuant to the target model for imbalance netting the Baltic TSOs shall sell and purchase Netted imbalances between each Baltic TSO and Not netted imbalances with a nominated Baltic TSO. The figure below depicts the target model setup for Baltic power system imbalance netting.

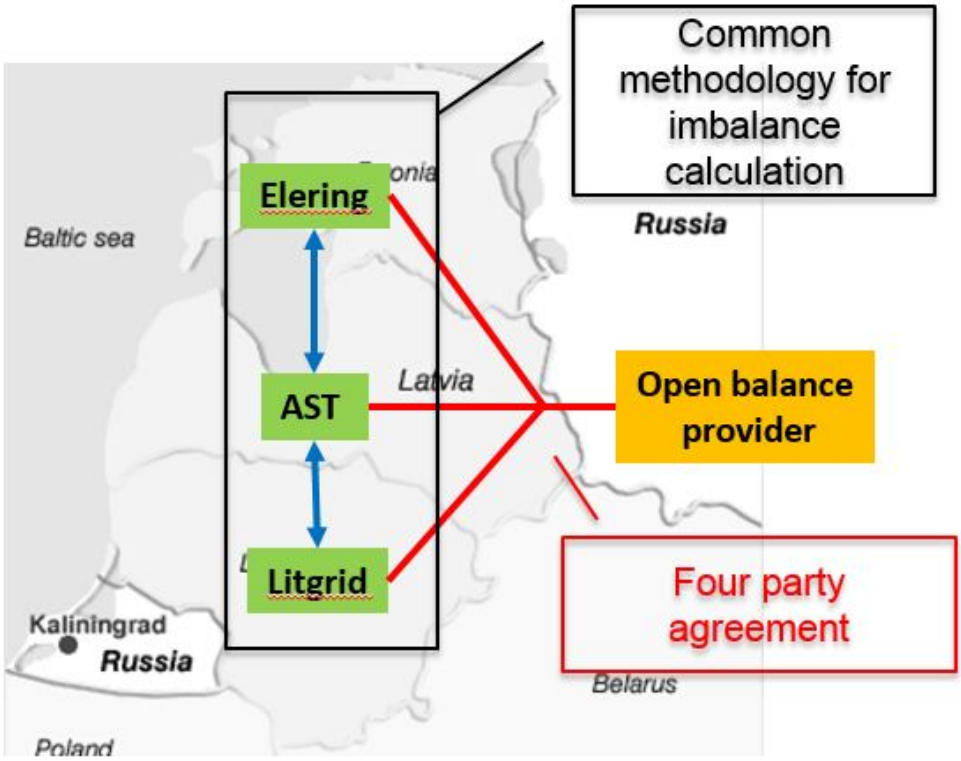

Figure 13: Target model setup for the Baltic power system imbalance netting.

The following benefits of the proposed target model are identified:

- Reduction of total imbalance amounts and cost for Baltic countries;
- Transparent procedures and pricing;
- Pre-condition for further integration and harmonization of the Baltic balancing markets;
- In line with the requirements of Electricity Balancing Network Code to establish Coordinated Balancing Area for Imbalance netting in Baltic region.

The table below contains description of functions in a target model setup for Baltic power systems imbalance netting:

Table 10: Description of functions in a target model setup for Baltic power systems imbalance netting.

	Baltic TSO	Nominated Baltic TSO
Data exchange	Data exchange between TSOs	Gathering of data from Data platform
		Calculations of imbalances volumes and prices
		Provision of calculation reports to Baltic TSOs
Settlement	Trades settlement of Not netted imbalances	Trades Not netted imbalances with Baltic TSOs
		Trades Not netted imbalances with Open balance provider

7.2.3. Main principles for imbalance netting within the Baltic power systems

Imbalance energy calculation

Imbalance netting principles shall be based on equal and non-discriminative principles, while reflecting the actual impact of the imbalance of a particular Balance area to the total imbalance of the Baltic area.

Netted imbalance volume for each Balance area shall be calculated considering the proportion of actual imbalance of a particular Balance area to opposite imbalances of other Balance areas.

Not netted imbalance volume for each Balance area shall be equal to difference of actual imbalance of Balance areas and netted imbalance volume.

Imbalance energy pricing

Imbalance energy prices for netted imbalance between Baltic TSOs shall be transparent and reflect the Baltic market situation. The Nordic TSOs price the imbalance power between two TSOs according to the average of the regulation prices. For ”no regulation hour” the price is the average of the relevant Elspot area prices. Similar approach could be applied in the Baltic area once a common Baltic regulation market is in place.

As long as Baltic regulation markets are not integrated, an interim solution for imbalance netting within Baltic power systems shall be applied apply. The selling and purchase prices for Netted imbalance shall be equal to the average Elspot prices of the Estonian, Latvian and Lithuanian bidding areas.

The selling price of Not netted imbalance shall be equal to the weighted average price of energy that is sold by the nominated Baltic TSO to Open balance provider.

The purchase price of Not netted imbalance shall be equal to the weighted average price of energy that is traded between the nominated Baltic TSO and the Open balance provider.

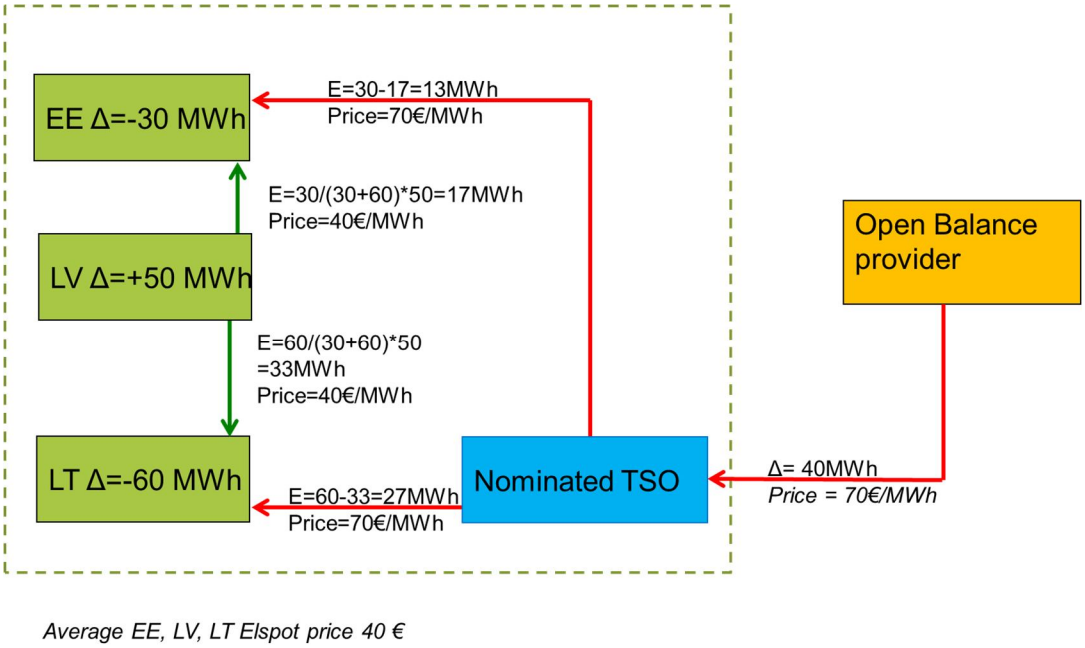

Figure 14: Example case for imbalance energy volume and pricing within Baltic power system.

7.3. Description of the new Nordics TSO-TSO balance settlement system (eSett).

7.3.1. New Nordic TSO-TSO balance settlement system (eSett)

The Finnish, Norwegian and Swedish TSOs have decided to implement a common imbalance settlement model in Finland, Norway and Sweden. The target is to

- contribute to a competitive common Nordic end user market,
- lower the threshold to enter the market, and
- enable market participants to expand into neighboring countries.

In the long run, the model will also lower the operational costs and make balancing related costs more transparent. The Nordic Balance Settlement (NBS) model will be a forerunner in imbalance settlement issues on the European level and take an important step towards wider market integration.

The Nordic Balance Settlement model aims to design and provide similar operational preconditions for all balance responsible parties regardless of the

country. Imbalance settlement all over the three countries will be performed with as similar principles as possible through one system. Rules and standards for information exchange will be harmonised as well.

7.3.2. Settlement and pricing principles

Principles of imbalance settlement and pricing remain mainly similar to those of the common Nordic balance service model introduced in 2009. The model is described more precisely in chapter 4.4 of the Work Package I report of this study. In brief, the main elements are:

- two balances: production and consumption balance
- two-price model for production balance and one-price model for consumption balance
- marginal pricing
- binding production plans
- common cost structure relating to balance service.

Euro is the default currency in which the imbalance settlement shall be done. However, it will be possible for the balance responsible parties to choose settlement in NOK or SEK for additional fee to cover the currency risk. Other fees, such as consumption and production fees, vary between the countries as the cost bases are national.

7.3.3. Market participants

The most significant change in the Nordic Balance Settlement model is the establishment of a new Imbalance Settlement Responsible (ISR). The imbalance settlement will be organized through it, and therefore a new operational company eSett has been established. The company is owned by Fingrid, Svenska Kraftnät and Statnett. Currently the company is building up a new IT-infrastructure. eSett will be the single interface for all balance responsible parties and eSett will be responsible for the following:

- Provide balancing related customer service to its customers,
- Manage imbalance settlement contracts,
- Perform imbalance settlement,
- Invoice/cred the balance responsible party for the balancing power and invoice other, balancing related fees (e.g. balance management and settlement costs and operational costs) on the behalf of TSOs,
- Manage collaterals and
- Operate and provide an imbalance settlement IT system that market participants can use.

A balance responsible party is a market participant having a valid agreement with the imbalance settlement responsible eSett. The BRP's responsibilities are the following:

- Provide the required collaterals,
- Plan balanced schedules on an hourly basis and submit them to TSO
- Act as the financial counterpart for the settlement of imbalances and activated imbalance adjustment and
- Inform eSett of which retailers the BRP is responsible of, for consumption and production per metering grid area.

The TSOs will still have the responsibility to supervise the balance of electricity system and take actions to rebalance the system. A TSO has the same responsibilities as a balance responsible party and in addition the following:

- Determine imbalance prices per hour,
- Submit necessary information per BRP to eSett, e.g. production plan and activated imbalance adjustment per hour,
- Act as the financial counterpart towards the BRP for all reservations of reserves and
- Report eSett which market balance area each meter grid area belongs to.

The chart below summarizes the relations between eSett and the market participants.

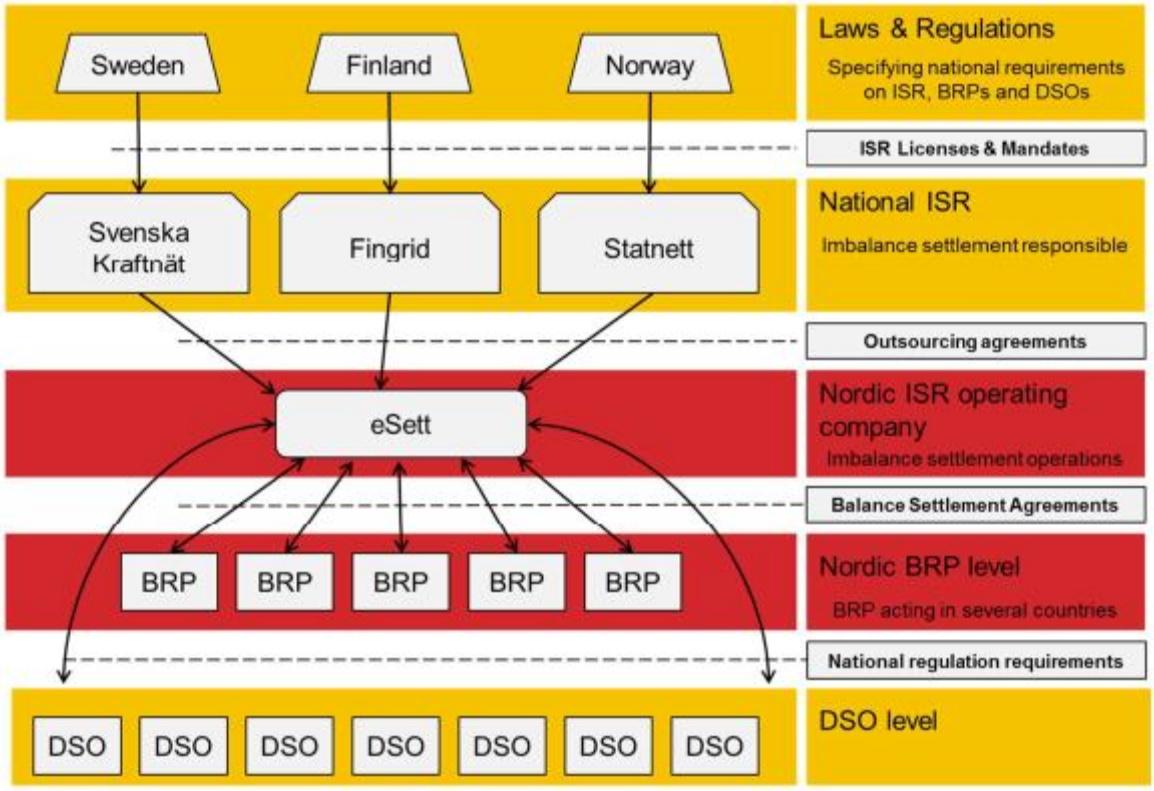

Figure 15: The relations between eSett and the market participants.

7.3.4. Data interchange and communication

The communication between the market participants and the Imbalance Settlement Responsible eSett is enabled largely by eSett's imbalance settlement IT system. Content-wise the communication is mainly of sharing settlement data between required stakeholders, but also various reports with information on the imbalance settlement and the performance of the market. A common data communication standard has been developed for the NBS to ensure fluent information distribution between all market participants.

7.3.5. Further details

The Nordic Balance Settlement will start operating gradually so that Finland will be the first country to implement the model in November 2015, while Sweden and Norway will join slightly later in February 2016. More information about the proceeding of the project and further details of the model can be found from the NBS website: http://www.nbs.coop/.

7.4. Perspective TSO-TSO imbalance settlement within the Baltic systems in comparison to the new Nordic TSO-TSO balance settlement system (eSett).

Target model for imbalance settlement within the Baltic region provides that there is established common methodology for imbalance calculation and imbalance netting within Baltic power systems.

Unlike for Nordic TSO-TSO balance settlement system (eSett), there would not be development of a separate party (Imbalance Settlement Responsible - ISR), but one of the Baltic TSOs would be nominated and responsible for gathering data from the common Data platform, calculating the imbalance volumes and prices and providing reports for the Baltic TSOs. Nominated TSO would trade the Not netted imbalances with Baltic TSOs and Open Balance Provider. The TSOs would be responsible for performing the balance control of its Balance area, gathering data from BRPs and submitting the needed system data to the platform, and performing imbalance settlement within the own system. BRPs in all systems are responsible for planning balance schedules and submitting them to TSOs.

7.5. Proposals for the actions needed to harmonise imbalance pricing and settlement principles within the Baltics and towards the Nordic system principles.

Common methodology for imbalance calculation and netting should be developed within the Baltic power systems, which also, for perspective harmonization reasons, should take into account principles based on Network Code on Electricity Balancing requirements and also principles used in the new Nordic TSO-TSO balance settlement system (eSett), where appropriate and feasible. This could include:

- marginal pricing for deliveries
- netting of imbalances between Balance areas
- selling and purchase price of Netted imbalance – average Elspot price
- selling and purchase price of Not netted imbalance – based on Open Supply prices.

Considering the perspective Baltic – Nordic balancing market integration and creation of level playing field for market participants within the integrated Baltic – Nordic region, the TSO - BRP imbalance pricing should be harmonized in Baltic countries. For this, in addition to the TSO – TSO balance settlement principles listed above, Nordic principles of TSO - BRP imbalance energy pricing should be considered.

Also, changes of the TSO – BRP imbalance pricing model would need further discussions with national market participants and Regulators by each TSO that shall consider power system security and socio-economic gain as base for introduction of different TSO–BRP imbalance pricing model.

Work Package III: Possibilities to harmonize the approach towards balancing energy exchange from mFRR within the Baltics and with the Nordics.

This work package contains an analysis of possibilities to develop the mFRR exchange between Baltic and Nordic systems based on separate mFFR markets:

1. Description of the target model of the common Baltic mFRR market.
2. Proposal of definition of mFRR standard products to be exchanged (the standard products for balancing capacity and for balancing energy).
3. Proposal of process for activation of balancing energy from mFRR.
4. Identification and proposal of needed changes to TSO-TSO settlement rules.
5. Needed Technical (IT) implementation scale (identification of the changes that would be needed to implement and operate mFRR exchange between Baltic and Nordic systems).
6. Identification of the key elements to take into account to ease the co-operation between the Baltic and Nordic mFFR markets through HVDC links.
7. Identification of the most important benefits and drawbacks of having cooperation between Baltic common merit order (CMO) and Nordic CMO in mFRR markets.
8. Roadmap of the expansion of cooperation between Baltics and Nordics towards common Baltic-Nordic mFRR market.

8. Description of the target model of the common Baltic mFRR market

Target model for Baltic common balancing market shall be based on the principle of common Baltic imbalance netting and settlement towards Russia/Belarus.

Balancing pricing should be more expensive than day-ahead and (in general) intraday market prices (according to NC requirements).Following are proposed principles of the common Baltic mFRR market:

- A common TSO-TSO settlement for ACE shall be in place.
- Activation of mFRR within the Baltics shall be based on the total Baltic ACE.
- There should be a common Baltic merit order list for upward and for downward balancing energy bids. The common merit order list and the information about changes in the merit order list during a day (for instance about bid activation, changes in amount and/or price of the bids etc.) should be available for all Baltic's TSOs. This assumes the development of current IT solutions or the development of a new common IT platform.
- Each TSO receives balancing bids from the BSPs in their own balance area and submits the offers to other TSOs or to the common IT platform. Thus, BSPs never interact directly with the TSOs of other balance areas.
- All the bids received by TSOs shall be submitted to the common merit order list TSOs are not allowed to keep the bids for their own use unless in cases as specified by NC on EB. The common principles of the unshared bids (if applicable) shall be defined by Baltic TSOs while implementing common Baltic balancing market.
- One of the Baltic TSOs shall initiate actions for activating the balancing bids.
- The activation of Balancing Energy bids shall be based on a TSO-TSO Model.
- The TSOs act jointly as one single buyer in the Baltic balancing market and cooperate in selecting the offers to use. Whenever an offer is selected, responsibility for ordering the BSP to activate the service is delegated to the local TSO.
- Activation of mFRR within the Baltic States shall be based on the most advantageous price criteria (merit order) of technically available mFRR bids within the Baltics. Nordic and Baltic mFRR bids are available for Baltic and Nordic TSOs unless congestion at cross-borders or in the internal grid is present.

- The algorithm applied for the optimisation of balancing energy bids activation of must be commonly developed.
- The developed technical activation process must take into account technical constraints, operational security issues and available cross-border capacity.
- The pricing of balancing energy shall be based on marginal pricing. If the analysis by the concerned TSO(s) demonstrates that pay as bid pricing methodology is more efficient, the latter could be considered for the transition period.
- The prices and volumes of balancing energy shall be published no later than two hours after the hour in question.
- Until the creation of the common Baltic-Nordic merit order list (or some common agreement regarding exchange of balancing bids), the Nordic offers can be ordered and settled only by connected TSO-TSO method.

The Baltic balancing market should also include a concept how to co-operate with 3-rd countries power systems. Following their participation conditions should be considered by Baltic TSOs:

- Baltic mFRR standard product or alternative agreed specific product for balancing energy exchanges with 3-rd countries should apply;
- Pricing principles of Baltic mFRR balancing market or alternative pricing solution should apply;
- Balancing procedures and settlement principles with 3-rd countries should facilitate non-discriminatory treatment of Baltic balancing market participants.

A concept of co-operation with 3-rd countries power systems should be analysed in more detail and this is foreseen in the common Baltic TSOs market study, which along with other topics includes analysis of treatment of electricity trade with the 3-rd countries. Co-operation with 3-rd countries power systems should be analysed from the broader perspective, taking into account different market set-up in EU and in the 3rd countries, reciprocity in electricity trading, long-term strategic goals of Baltic States in energy sector and etc.

Target model structure for Baltic Common Balancing Area (CoBA) is outlined in the table below:

Table 11: Target model structure for Baltic's CoBA.

	Day Ahead Market	Intraday Market	Balancing Market	Settlement of balance area's ACE	Settlement of balancing deliveries	Imbalance settlement
Deadline	**D-1**	**H-1**	**Intra-hour**	**D+1**	**D+1**	**M+15**
Chain	NPS and BRP > TSO	NPS and BRP > TSO	TSO-TSO-BSP	TSO-TSO	TSO-TSO-BSP	TSO-BRP
The goal	Physical trading	Extra-trading with purpose to avoid imbalance energy	System balancing: CoBa shall be based on total Baltic's ACE.	Imbalance netting inside the Baltic's CoBA. Not-netted imbalance energy traded with open balance provider.	Each TSO shall settle the activated volume of balancing energy with the BSP in its balance area and between other areas	Each TSO shall calculate the Imbalance for each BRP
The pricing principles	Marginal pricing		The pricing methods shall be based on marginal pricing.	The price of netted imbalance is based on average Elspot prices of Baltic's bidding area. The price of not-netted imbalance is based on Open Supply price.	Marginal pricing	Input shall be based on balancing market prices. Incentives to reduce imbalance.
Pre-conditions	OK	OK	Common ACE agreement; New IT solutions or common platform and bid activation algorithms should be developed.			Harmonization of imbalance pricing model should be analysed separately

9. Proposal of definition of mFRR standard products to be exchanged (the standard products for balancing capacity and for balancing energy).

9.1. Standard products target model

Below are outlined definitions and requirements for standard products for balancing energy exchange based on Network Code on Electricity Balancing.

Standard Product means a harmonised Balancing product defined by all TSOs for the Exchange of Balancing Services.

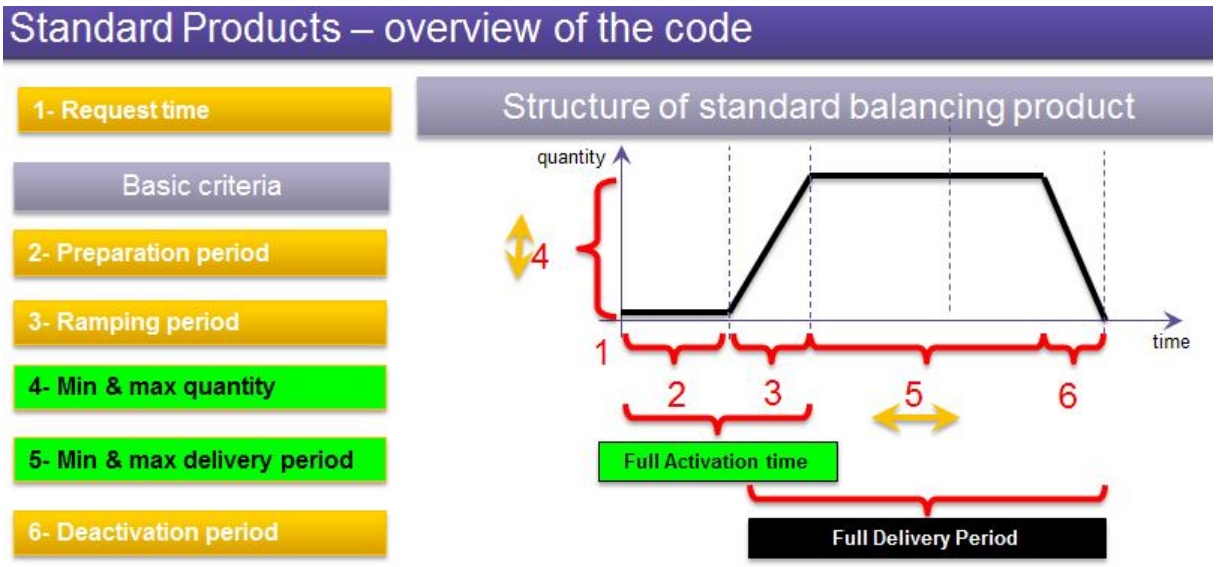

Figure 16: Standard balancing products based on Network Code on Electricity Balancing requirements.

The Standard Products for Balancing Capacity and Standard Products for Balancing Energy shall consist of at least the following standard characteristics and information related to a bid defined by a fixed value or an appropriate range, depending on the requirements of the system and type of product, as listed in table below:

Table 12: Characteristics of standard products for balancing energy exchange.

Standard Products	**Item in the Figure**	**Definition**
(a) Preparation Period	2	**Preparation Period** means the time duration between the request by the TSO and start of the energy delivery.
(b) Ramping Period;	3	**Ramping Period** means the time when the bid starts the physical activation, delivers the first MW and approaches the requested power of the TSO.
(c) Full Activation Time;	2 + 3 = preparation period + ramping period	**Full Activation Time** means the time period between the activation request by TSO and the corresponding full activation of the concerned product.
(d) minimum and maximum	4	

quantity;		
(e) Deactivation Period;	6	**Deactivation Period** means the time period for ramping, from full delivery or withdrawal back to a set point.
(f) Price of the bid;		The price of Balancing Energy in €/MWh
(g) Divisibility;		**Divisibility** means the possibility for the TSO to use only part of the Balancing Energy bids or Balancing Capacity bids offered by the Balancing Service Provider, either in terms of power activation or time duration.
(h) minimum and maximum duration of Delivery Period;	5	**Delivery Period** means a time period of delivery during which the Balancing Service Provider delivers the full requested change of power in-feed or withdrawals to the system.
(i) Full Delivery Period (not separately standard product)	3 + 5 + 6 = ramping period + MIN/MAX duration of Delivery Period + Deactivation Period	
(j) Location		
(k) Validity Period;		**Validity Period** means the time period when the Balancing Energy bid offered by the Balancing Service Provider can be activated, whereas all the characteristics of the product are respected. The Validity Period is defined by a beginning time and an ending time. *At least the Full Delivery Time.*
(l) Mode of Activation;		**Mode of Activation** means the implementation of activation of Balancing Energy bids, manual or automatic, depending on whether Balancing Energy is triggered manually by an operator or

		automatically by means of a closed-loop regulator.
(m) Minimum duration between the end of Deactivation Period and the following activation.		The minimal duration between the end of Deactivation Period and the following activation, which allows a time to recover the capacity to provide the service once again.

9.2. Compatibility between Nordic and Baltic current mFRR products

The following table contains data on compatibility of current mFRR products in Nordics and Baltics:

Table 13: Compatibility between Nordic and Baltic current mFRR products.

Standard Products	**EE**	**LV**	**LT**	**FI**	**SE**
Preparation Period (2)	0 min There is a possibility to agree some preparation period during the phone call to power plant.	From 0 to several minutes – can be agreed on phone call.	from 0 to few minutes. Agreed during the phone call.	Agreed during the phone call	Agreed during the phone call
Ramping Period (3)	10 min (in some few cases up to 20 min)	<15 min.	< 15min	≤15 min	≤15 min
Full Activation Time (2 + 3)	10 min (or in some cases 20 min) + sometimes preparation period	< 15 min + preparation time if agreed	15 min + preparation period	15 min	15 min
Minimum and maximum	MIN = not determined	MIN = not determined	MIN = 5 MW MAX = no	Currently MIN = 10 MW. Will be reduced to 5 MW	

quantity (4)	MAX = no restrictions	MAX = no restrictions	restrictions	(already today 5 MW in Southern Sweden, SE4) MAX = no restrictions.	
Deactivation Period (6)	Not determined	Not determined	According to technical characteristic of the unit	≤15 min	≤15 min
Pricing Method	Pay as bid	Pay as bid	Pay as bid	Marginal price	Marginal price
Divisibility	Offers are divisible	Offers are divisible	Offers are divisible	Offers are divisible	Offers are divisible
Minimum and maximum duration of Delivery Period (5)	No formal requirement, MIN = 1 min; MAX = 60 min (but not more than until the end of operational hour).	Different products for different durations: 15min, 30min, 45min, 60min	No formal requirement, MIN = 1 min; MAX = 60 min.	No formal requirement, MIN = 1 min; MAX = 60 min.	
Full Delivery Period (3 + 5 + 6)	= 3+5 (ramping period + MIN/MAX duration of Delivery Period)	3 + 5	= 3+5+6 (ramping period + MIN/MAX duration of Delivery Period + Deactivation Period)	5	5
Validity Period (at least 3+5+6)	60 min	60 min	60min	60 min	60 min
Mode of Activation	Manual	Manual	Manual	Manual	Manual

Minimum duration between the end of Deactivation Period and the following activation.	Not determined	Not determined	Not determined	-	-
Settlement volume determination: Start end time of the order (3 + 5 + 6)?	3+5	3 + 5	3+5+6	5	5
Gate closure of the offers	H-45min	H-15min	H-30min	H-45min	H-45min
Firmness of the offers	offers are not firm, i.e. market participants have no responsibility to guarantee the availability of this capacity for specific operational hour.	offers are not firm, i.e. market participants have no responsibility to guarantee the availability of this capacity for specific operational hour.	All received offers are firm (fixed).	All received offers are firm (fixed). Market participant has responsibility to inform TSO if there are unplanned technical restrictions to execute the offer.	

Comments:

1) *All TSOs of a Coordinated Balancing Area shall commonly define and agree on Balancing Energy Gate Closure Times (NC article 31).*

2) *After the Balancing Energy Gate Closure Time the update of a Balancing Energy bid for a Standard Product in a Coordinated Balancing Area is no longer permitted. After this time the volume and price of Balancing Energy bids can only be changed with approval of all TSOs of the concerned Coordinated Balancing Area.*

9.3. Evaluation of required changes for national mFRR products

The following is the evaluation of required changes for national mFRR products for Estonian, Latvian and Lithuanian mFRR products taking into account the Nordic mFRR product as the reference product.

Estonia

- **Preparation Period.** According to the bilateral agreements with the Estonian market participants, the preparation period as such is not mentioned. In practice, however, the preparation period has sometimes been used. Needed change would be to add a condition that the preparation period will be agreed during the phone call. Also, the maximum time for the preparation period during an operational hour must be determined.
- **Ramping Period.** As a rule, ramping period is 10 minutes which is less than up to 15 minutes ramping period in the Nordic countries and in other Baltic countries. Needed change would be to remove the 20 minute ramping period, except for some large bids. Downside is that in some cases it will reduce the volume of the bids.
- **Full Activation Time.** Changes in the preparation period and ramping period will be sufficient for the harmonization of mFRR product full activation time.
- **Minimum and maximum quantity.** There is no need to set the limitation to the maximum quantity. Needed change is to set minimum quantity at 5 MW.
- **Deactivation Period.** According to bilateral agreements with the Estonian market participants the deactivation period is not described. Needed change is to determine deactivation period, which should be less than 15 minutes.
- **Price of the bid.** The market participants are currently paid for delivered mFRR energy by using the pay as bid principle. Needed change is to introduce marginal pricing.
- **Divisibility.** All offers are divisible. There is no need for changes.
- **Minimum and maximum duration of Delivery Period.** Minimum delivery period is in practice 1 minute and maximum delivery time is one operational hour. There is no need for changes.
- **Full Delivery Period.** Currently, full delivery period consists of the ramping period and from the delivery period. There is a need for a change here. If one moves towards European harmonised balancing product then

deactivation period must be added. In case of harmonisation with Nordic countries, the ramping period must be removed.

- **Validity Period.** Currently, full delivery period consists of the ramping period and from the delivery period and the product must be valid during the whole operational hour. There is no need for changes.
- **Mode of activation.** Activation is done manually like in the Nordic countries and in other Baltic countries. There is no need for changes.
- **Minimum duration between the end of Deactivation Period and the following activation.** This period is not determined. In practice this period has not been necessary. There is no need for changes.
- **Settlement volume determination.** Currently settlement volume determination consists of the ramping period and from the delivery period. There is a need for a change here. If one moves towards European harmonised balancing product then deactivation period must be added. In case of harmonisation with Nordic countries the ramping period must be removed.
- **Gate closure of the offers.** Gate closure is 45 minutes before the operational hour like in the Nordic countries. There is no need for changes.
- **Firmness of the offers.** Currently, the offers are not firm. Needed change is to make offers firm and to place the market participants with the responsibility to inform the TSO in advance in case there are technical restrictions to execute the offer.

Latvia

- **Preparation Period.** Not defined in bilateral agreements. Instead, it is mutually agreed that there could be a shift in the start of activation time, but it could not be more than several minutes. Needed changes would be to add the preparation time and set limits for that.
- As **Ramping Period** is in line with the Nordics, then **Full Activation Period** would also correspond to that after changes in Preparation Period would be done.
- **Maximum and minimum quantity.** For bids is not determined, changes would be necessary to set minimum quantity of 5 MW.
- **Deactivation Period.** Is not determined, this should be changed to < 15 min.
- **Pricing method.** Change of the pricing method from Pay as Bid to Marginal Pricing is feasible if Baltic countries join the Nordic Balancing

Market – introducing the Marginal Pricing system for Latvia before joining the large market is not feasible because of the low liquidity.

- **Divisibility.** Offers are divisible, there is no need for a change.
- **Minimum duration**. The Delivery Period could be reduced to 1 minute, but no practical use for that is foreseen by the Latvian TSO.
- **Full Delivery Period.** Currently, it consists of the Ramping Period and the Delivery Period. Changes could be needed for the harmonisation with the Nordics. All changes must be in line with EC NB. This also applies to **Validity Period** and **Settlement Volume Determination**.
- **Gate closure of the offers**. Is 15 minutes now, it could be changed to 45 minutes to be in accordance with the Nordics, but there could be a downside for that - taking into account specific conditions of the hydro power stations in Latvia, it would affect the number of bids.
- **Firmness of the offers.** Offers could be made firm which would make market participants responsible for guaranteeing the availability of capacity.

Lithuania

- All changes regarding Deactivation Period, Settlement volume determination and etc. would require the removal of the evaluation of technical characteristics of the generating units in the settlement process, therefore it could impact the price of mFRR.
- Introduction of H-45min gate closure for the offers would require to adjust the scheduling process timeline while leaving less time for Balance responsible parties to submit intraday schedules and offers for mFRR.
- Previously mentioned changes could be feasible to implement while integrating balancing markets and creating Baltic or Nordic-Baltic standard mFRR product with a common merit order list, where benefits of a bigger integrated mFRR market can be achieved.
- A change of pricing method from Pay as Bid to Marginal together would be a major change both for the mFRR market and imbalance prices. Evaluation shows that introduction of Marginal pricing can be beneficial only in a liquid market, therefore such change could be feasible to implement while integrating balancing markets and creating Nordic-Baltic standard mFRR product with a common merit order List.

9.4. Proposal of definition of mFRR standard products to be exchanged

All technical requirements for Baltic mFRR standard product could be harmonized with Nordic standard product. It is important to note that according to the NC on EB requirements the pan-European standard product(s) shall be defined by all TSOs, therefore Baltic and Nordic mFRR standard product(s) shall be in line with the pan-European standard products defined by TSOs.

The table below contains characteristics of proposed Baltic mFRR standard product for balancing energy exchange:

Table 14: Characteristics of proposed Baltic mFRR standard product for balancing energy exchange.

Standard Products	**The proposal of definition of mFRR standard products to be exchanged**
Preparation Period (2)	Agreed during the phone call
Ramping Period (3)	<15 min
Full Activation Time (2 + 3)	15 min
Minimum and maximum quantity (4)	MIN = 5 MW MAX = no restrictions
Deactivation Period (6)	< 15 min
Pricing Method	Marginal price
Divisibility	Offers are divisible
Minimum and maximum duration of Delivery Period (5)	MIN = 1 min; MAX = 60 min (but not more than until the end of operational hour).
Validity Period (at least	60 min

3+5+6)	
Mode of Activation	Manual
Minimum duration between the end of Deactivation Period and the following activation.	Not determined
Settlement volume determination: Start end time of the order (3 + 5 + 6)?	5
Gate closure of the offers	H-45min
Firmness of the offers	All received offers are firm (fixed). Market participant has responsibility to inform TSO if there are unplanned technical restrictions to execute the offer after the Gate closure but not later than exact order.

Additionally to the proposed Baltic mFRR standard product the necessity for the specific balancing products within Baltic region should be further analysed and the impact for balancing energy market should be assessed by Baltic TSOs and national regulatory agencies for compliance with NC on EB requirements.

10. Proposal of process for activation of balancing energy from mFRR

Below is a list of proposals for the activation process of balancing energy from mFRR in a common Baltic merit order list:

- Activation of mFRR within the Baltics shall be based on the total Baltic ACE.
- One of the Baltic TSOs shall initiate actions to offset the total Baltic ACE within the predefined limits
- Activation of mFRR within the Baltic States shall be based on the most advantageous price criteria (merit order) of technically available mFRR bids within the Baltics unless congestion at cross-borders or in the internal grid is present.

- The activation of balancing energy bids shall be based on a TSO-TSO Model;
- There should be at least two common merit order lists. One list should be for upward balancing energy bids and the other for downward balancing energy bids.
- Offers are selected according to merit order unless congestion at cross-borders or in the internal grid is present;
- The developed technical activation process must take into account technical constraints, operational security issues and available cross-border capacity.
- Until the creation of the common Baltic-Nordic merit order list (or some common agreement regarding exchange of balancing bids), the Nordic offers can be ordered and settled only by connected TSO-TSO method.

11. Identification and proposal of needed changes to TSO-TSO settlement rules

Baltic's balancing market and pricing principles

The principles for the exchange volume and price determination for balancing energy, as described below, is based on the assumption that the agreement between the Baltic TSOs and Open Balance Supplier is effective, and balancing is executed based on the common Baltic ACE. It is important to note that principles of the open balance supply agreement for balancing based on the common Baltic ACE may change.

Scenario A: No congestions

- Activation of mFRR within the Baltics shall be based on the total Baltic ACE by using TSO-TSO model;
- One of the Baltic TSOs shall initiate actions for balancing for which new IT solutions or a common IT platform with algorithms should be developed
- There shall be TSO-TSO settlement for netted imbalance, not-netted imbalance and balancing deliveries between Baltic TSOs:
    - The price of netted imbalance shall be based on the price of mFRR balancing energy deliveries. For "no regulation hour" the average price of the Baltic's Elspot bidding areas should be used;

- The price of not-netted imbalance shall be the weighted average price based on the Baltic's ACE tariffs for Open Balance Supply;
- The pricing of mFRR balancing energy deliveries shall be based on marginal pricing.

Following applies to the marginal pricing method:

- When the delivery hour has passed, the price of the most expensive up regulation offer, which has been activated in the balancing market becomes the up regulating price, which is the price paid to all activated up regulation offers;
- Similarly, the lowest activated down regulation bid defines the down regulation price, which is paid to all activated up regulation offers;
- This marginal price mechanism is used to stimulate BSPs to submit reasonable offers, also the marginal pricing supports equally cost-based settlement between TSO-TSO;
- If there were both up and down balancing during the hour, the dominating direction determines whether it is an up- or down-regulation hour.

Marginal pricing method for the settlement between Baltic TSOs would be cost-based between TSO-TSO-BP and transparent.

By using marginal pricing the settlement would be equal between areas because TSO should pay to BSP in its area.

The following are two possible options for imbalance energy netting that may be applied within the Baltics.

<u>mFFR settlement option 1. Proportional distribution of activated mFRR volumes.</u>

Balancing delivery should be divided between the TSO's proportionally according to intra-hour imbalance values. The share of total balancing deliveries for each power system (Party) is determined according to the Party's proportional share of Baltic's total netted imbalance as follows:

$$\text{Balancing delivery share } \% = \frac{I_i}{\sum I_{\text{int}\,ra}} = k_{\text{int}\,ra}$$

I_i – the intra-hour imbalance of a particular Balance area excluding activated balancing energy;

$\sum I_{intra}$ = Total in the same direction intra-hour imbalance compared to the total imbalance of Baltic balance area;

k_{intra} = the share of balancing delivery for Party.

The following figure contains principles of proportional imbalance netting and settlement:

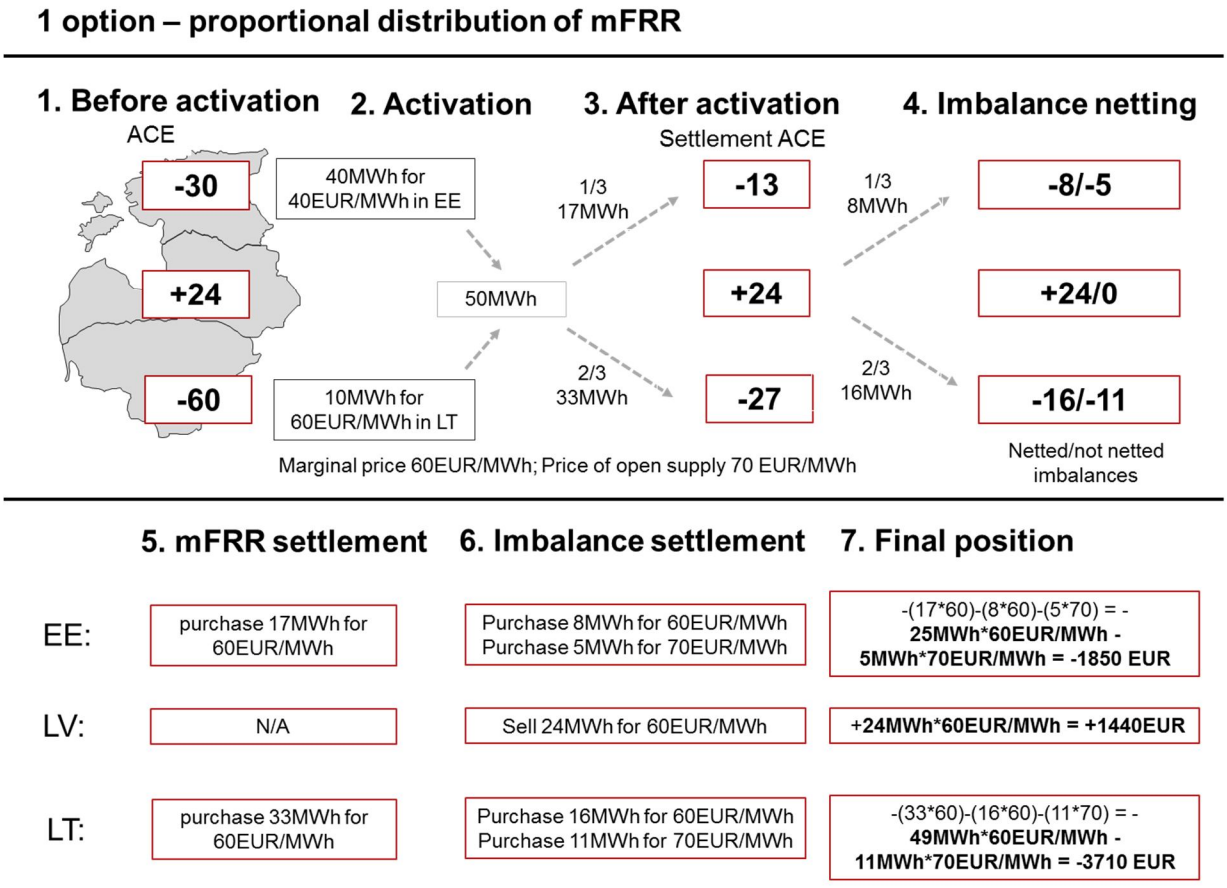

Figure 17: Proportional imbalance netting and settlement principles.

<u>mFRR settlement option 2. Activated mFRR volumes are included in imbalance proportional distribution of imbalances.</u>

Balancing deliveries for each power system (Party) shall be determined without the inclusion of mFRR activations in "scheduled position". Activated balancing energy supplies shall be included while calculating ACE of relevant power systems. Subsequently the share of netted imbalance energy for each power system shall be determined according to the Party's proportional share of Baltic's total netted imbalance:

$$\text{Netted imbalance share}\,\% = \frac{I_{i^*}}{\sum I_{\text{int}\,ra^*}} = k_{\text{int}\,ra^*}$$

I_{i*} – the intra-hour imbalance of a particular Balance area including activated balancing energy supplies within the particular system;

$\sum I_{intra*}$ = Total in the same direction intra-hour imbalance compared to the total imbalance of Baltic balance area including activated balancing energy supplies within the particular system;

k_{intra*} = the share of balancing delivery for Party including activated balancing energy supplies within the particular system.

The following figure contains principles of proportional imbalance netting and settlement:

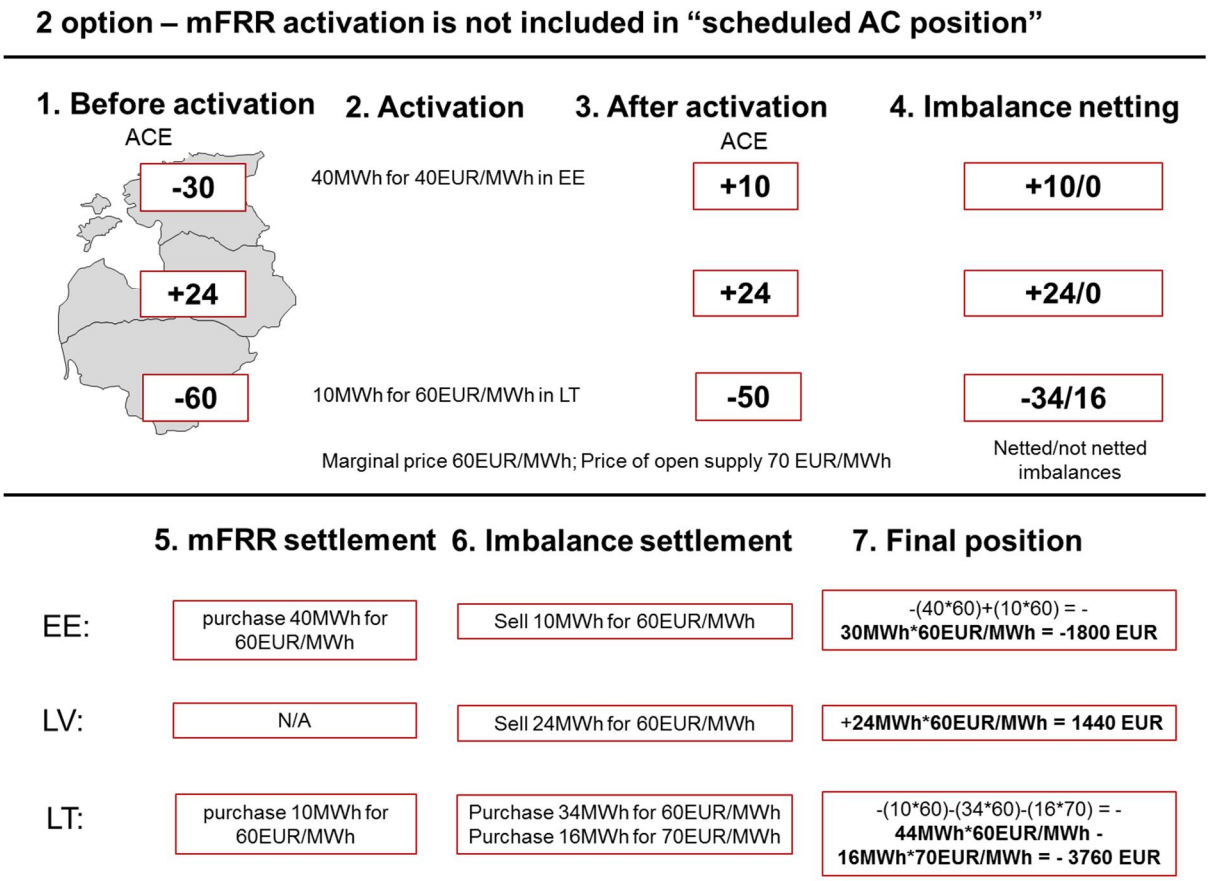

Figure 18: Imbalance netting and settlement principles without inclusion of mFRR activations in "scheduled position".

- **Settlement of balancing energy with BSP**
  - Each TSO shall settle the activated volume of balancing energy with the BSP located in the respective TSO's balance area;
  - Each TSOs shall calculate the activated volume of balancing energy to be used as an imbalance adjustment, and apply the volume to the concerned BSP's balance report.

- The price of the balancing energy procured or sold by TSOs from/to BSPs and/or other TSOs shall be as a main component of the price for the imbalance energy traded between TSOs and BRPs.

- **Settlement of balancing energy between TSOs**

  - The settlement of balancing energy between the Baltic TSOs is handled in the same way as the common imbalance settlement by using the Settlement Coordinator function.

  - As the connected TSO is responsible for settlement with the BSP located in the respective TSO's balance area, then TSO-TSO settlement reports for each Party shall be organised by the Baltic Settlement Coordinator with the purpose to ensure the equal cost sharing between Baltic TSOs.

When there is no congestion, the balancing price will be the same for the whole Baltic region.

Scenario B: Congestion on cross-borders

- In the presence of congestion, balancing bids may be picked outside the merit order since balancing must be carried out taking into account the geographical factors. In this case, the region will be split into smaller areas and there will be different balancing prices for each area (and also different imbalance prices).

- Bids used for special regulation (such as countertrading) are not allowed to influence the balancing price for the hour.

12. Needed Technical (IT) implementation scale (identification of the changes that would be needed to implement and operate mFRR exchange between the Baltic and Nordic systems)

Current IT tools of Baltic TSOs are mostly based on local needs and include some cooperation between Baltic TSOs in accordance with bilateral agreements. Operation of common Baltic mFRR market requires establishment of common IT tools for the Baltic TSOs to execute the processes of submission of bids, activation and settlement. Common IT tools also provide the same level access to the data and information for all TSOs.

The following is the principle indication for the needed Technical (IT) implementation scale issues that are needed to address while implementing common Baltic balancing market solution.

12.1. Common Baltic market implementation scale

In order to operate the common Baltic mFRR market, the following information as a minimum shall be available for all TSOs:

1. Planning data
    1.1. Scheduled AC balance
    1.2. Scheduled flow on DC links
    1.3. Transmission limitation on the cross borders
    1.4. mFRR offers
    1.5. Day-ahead prices
    1.6. Price offer from open balance service provider
2. Real time data
    2.1. ACE of each power system
    2.2. Actual flow on DC and AC links
    2.3. Available transfer capacity on the cross borders
    2.4. Total Baltic ACE
    2.5. Information about the order of mFRR
    2.6. Operational information about activated bids from the Baltic mFRR CMO
    2.7. Operational information about activated balancing energy from other sources (HVDC, Belarus, Russia)
3. Settlement data
    3.1. Actual metering data of AC balance
    3.2. Settlement data of activated bids from Baltic mFRR CMO
    3.3. Settlement information about activated balancing energy from other sources (HVDC, Belarus, Russia)

Development of the Baltic common IT tools for operating the Baltic mFRR market can be arranged in two ways:

1. Common IT process. Baltic TSOs can update the existing IT systems and establish common data exchange and coordination process. Thus all planning, real time and settlement data would be exchanged between separate IT systems and processes according to the agreed requirements.

2. Common IT platform. New IT platform can be developed to provide one common tool to be used by all Baltic TSOs to manage Baltic the mFRR market. Thus, all required information from the local IT systems should be provided to the common IT platform and all processes should be integrated between local IT systems and common IT platform.

Both options require the initiation of project with the project team consisting of members from all the Baltic TSOs. S.W.O.T assessment of possible options is provided in the table below:

Table 15: S.W.O.T assessment of options for IT solutions to operate the Baltic mFRR market.

	Common IT process	Common IT platform
Strengths	• Possibility to adjust individual IT system to suit common process needs and individual TSO requirements.	• Single point of data node for Baltic region; • Development of other common market and operational processes between Baltic TSOs
Weaknesses	• No single point of data node for Baltic region. • Complex solution to handle real time data between 3 separate IT systems	• Requirements of one TSO can not be implemented if they are not accepted by other TSOs • Additional resources are required to maintain the Common IT platform
Opportunities		• Better integration possibilities towards other EU IT systems
Threats	• Future integration with other EU IT systems would require additional coordination between	• Breakdown or malfunction of Common IT platform would impact all Baltic power systems

	Baltic TSOs • Implementation of common processes can be restricted by development limits of local IT systems	

Common IT platform should be considered as a more efficient solution taking into account easier implementation of other common processes between the Baltic TSO that will be required by future network codes. Also, it could provide better integration possibilities with other common platforms.

12.2. Baltic - Nordic market cooperation implementation scale

There is at least three possible options how to enable communication between Nordic Operational Information System (NOIS) and Baltic TSOs to enable mFRR exchange.

1. To establish a communication link between NOIS and the foreseen common Baltic platform. The communication with NOIS can be enabled with interface called Electronic Highway. The file format used in communication is XML and the message format is based on ETSO's definition.

2. To use mFRR section of NOIS as it is in the Nordics. This option would grant access to the mFRR section for the Baltic TSOs. This option would most likely need further system development for NOIS.

3. To grant full access to NOIS for Baltic TSOs. This option would most likely need further system development for NOIS.

Further development plans how to implement and operate communication between NOIS and the common Baltic platform and other possible solutions should be coordinated with the Nordic NOIS System Group (NSG) where all the Nordic TSOs are represented.

13. Identification of the key elements to take into account to ease the co-operation between the Baltic and Nordic mFFR markets through HVDC links.

Following are key elements to take into account to ease the co-operation between the Baltic and Nordic mFFR markets through HVDC links.

- Creation of Coordinated Balancing Area in Baltics.
- Creation of common Baltic mFRR balancing market.
- Agree on common Nordic – Baltic mFRR product(s).
- Creation of cooperation model to minimise balancing costs in Nordic-Baltic region.

Harmonisation of the procedures and principles for the exchange of balancing energy through the HVDC links connecting Nordic and Baltic countries.

Development of technical procedures for ordering and activation of mFRR bids through HVDC links. Technical procedures for ordering and activation of mFRR shall facilitate Fingrid, Svk, Elering, Litgrid or a designated Nordic/Baltic TSO coordinator to order balancing energy from mFRR in any of the Nordic or Baltic power system for the purpose of balancing Baltic / Nordic power systems. Developed procedures shall include the provision that the power flows of HVDC links can be handled only by the connected TSOs (i.e. mFRR bids through HVDC links shall be activated only by TSO(s) of adjacent power systems connected by HVDC links).

Agree on the process of integrating the Baltic – Nordic balancing markets step by step and different steps shall be tested during the process.

While developing standard mFRR product(s) to be exchanged the ramping limits and other technical limitations of HVDC links shall be taken into consideration and be addressed.

14. Identification of the most important benefits and drawbacks of having cooperation between Baltic common merit order (CMO) and Nordic CMO in mFRR markets.

Benefits of cooperation between common Baltic merit order and Nordic common merit order:

- More competition on the mFRR market in the Nordics as well in the Baltics. More robust market to manage deviations in supply and interconnectors. Enables to use the available mFRR resources in a more effective way and enhances the security of supply.
- More efficient use of the transmission capacity enabling to even the balancing energy prices (and conditions for the market participants) within the integrated Baltic electricity markets.

- Optimisation of Nordic and Baltic power system balancing while avoiding opposite balancing between the separate balancing areas / power systems.
- To provide an example of well-functioning multinational mFRR market in order to contribute to the target model for the rest of Europe.

Drawbacks if there is no cooperation between Baltic and Nordic balancing markets:

- Non optimal model for balancing in Nordic-Baltic region;
- If no cooperation between Baltic- Nordic balancing markets is in place then even when the capacities between Baltic and Nordics shall not be fully utilised there shall be different balancing prices in Baltic / Nordics – hence not equal conditions for the market participants in an otherwise integrated Baltic- Nordic power market. This also means hindrance to an optimal utilization of the existing and foreseen interconnectors in the region;
- If the harmonization of Baltic-Nordic balancing markets is not fully achieved there might be unbalanced competition situation between the market participants. This would endanger the trustworthiness of both markets.

15. Roadmap of the expansion of cooperation between Baltics and Nordics towards common Baltic-Nordic mFRR market.

Baltic – Nordic balancing market cooperation development process may be split into four parts:

- Development of current TSO-TSO assistance, testing new functions and extending TSO-TSO assistance to NordBalt DC connection,
- Creation of a common Baltic CoBA (including TSO-TSO imbalance agreement and common balancing market),
- Establishment of cooperation between the common Baltic and Nordic balancing markets aiming at CMO, and
- Creation of common Baltic – Nordic balancing market.

The draft proposals and agreed plans for the development of a common Baltic balancing market and cooperation between the Baltic and Nordic balancing markets shall be communicated to and consulted with the market participants and other relevant authorities.

15.1. Development of current TSO-TSO assistance, testing new functions and extending TSO-TSO assistance to NordBalt DC connection

Taking into account the foreseen development of Baltic mFRR market the current TSO-TSO assistance between Fingrid and Elering should be further developed and new possibilities for cooperation should be tested. Tested and proven well-functioning principles should be implemented. After commissioning of NordBalt DC connection, the cooperation could be extended to take place between Svenska Kraftnät and Litgrid with harmonized principles if agreed between relevant parties.

The cooperation should be developed stepwise and starting with limited mFRR exchange volumes taking into account the technical limitations. This kind of assistance could also be extended to include a Baltic TSO - Nordic mFRR market CMOL cooperation model where it would be possible to activate more mFRR bids than just the bids available in the connecting countries.

15.2. Creation of common Baltic balancing market

A common Baltic imbalance netting solution needs to be implemented as a stepping stone for the development of the Baltic individual balancing markets into a common Baltic balancing market.

It is important to point out, that before creating the common Baltic balancing market the harmonization of the overall balance management systems in different countries shall be analysed and as a result the harmonisation of the main principles (planning principles, requirements for the measurement principles, etc.) shall be implemented. Additionally the necessity for the specific balancing products in one or more system has to be analysed. In this case impact of the specific products on volumes of balancing energy available from standard product bids should be considered.

The creation of common Baltic balancing market shall encompass the following steps:

- Decision on the common Baltic balancing market principles (What):
    - Introduction of Baltic standard mFRR product by Baltic TSOs;
    - Activation of standard mFRR product;
    - Settlement procedures;
- Decision on the implementation of the common Baltic balancing market principles (How):
    - Specifications of activation of standard mFRR product;

- Specifications of settlement procedures;
- Specifications of needed IT solutions;

- Decision on the responsibilities and timelines for the implementation of the common Baltic balancing market principles (Who and When);
- Decision on the balance portfolio model and harmonised imbalance pricing internally in Baltic power systems;
- Introduction of Baltic standard mFRR product meeting Nordic mFRR technical requirements, also considering the Network Code on Electricity Balancing requirements;
- Creation of common Baltic balancing bid merit order list;
- Implementation of needed IT solutions (common Baltic balancing platform);
- Introduction of common Baltic mFRR product activation procedures;
- Introduction of common Baltic balancing market settlement procedures;
- Introduction of common Baltic balancing pricing, balance portfolio model and harmonised imbalance pricing internally in Baltic power systems;

The above steps may go in parallel and not necessarily in the outlined order.

15.3. Establishment of cooperation between common Baltic and Nordic balancing markets aiming at CMO

Following steps on expansion of cooperation between Baltic and Nordic balancing markets are subject to the Nordic and Baltic TSOs decision regarding expansion of the cooperation across region.

The Baltic and Nordic balancing market cooperation may proceed step by step. Each step shall be tested and then implemented. Thus expansion of Baltic and Nordic balancing market cooperation may go in parallel and depending on the following developments of Baltic and Nordic balancing markets.

- Exchange of the Baltic and Nordic balancing merit order lists between TSOs for information and testing purposes;
- Harmonization of mFRR product exchanged between FI-EE and LT-SE*;*
- Creation of the model for cooperation between common Baltic and Nordic balancing markets aiming at CMO;

- Decision on cooperation of Baltic - Nordic separate CMO and mFRR product activation and settlement procedures;
- Implementation of the model for cooperation between common Baltic and Nordic balancing markets aiming at CMO and needed IT solutions.

15.4. Creation of common Baltic – Nordic balancing market

After having a proven and successful operation between the Baltic CoBA and Nordic CoBA, then the integration of mFRR markets with similar market setups can be considered as final target. Parallel to the creation of common Baltic - Nordic balancing market also other harmonization processes (such as German, Netherlands, UK and Polish markets) might happen, as the ultimate goal is to have common European-wide balancing market. These harmonization processes call for creation of mechanisms to ensure an efficient and co-ordinated co-operation between Nordic mFRR market and neighbouring markets.

Work Package IV: Conclusions and Recommendations.

This work package contains a roadmap with recommendations regarding actions for cooperation between the Baltics and Nordics in the area of balancing energy exchange from mFRR.

The conclusions and recommendations are based on the results of the work packages of I, II, and III of this study.

16. Conclusions and recommendations on possibilities to develop the mFRR exchange based on current situation

Taking into account the current status of individual Baltic balancing markets the following needs to be considered:

- *Current practices of procurement and activation of mFRR bids inside the Baltic power systems are not harmonised:* there are differences in terms of bid volume, firmness, and order size and activation time.
- *TSO - TSO exchange of mFRR bids between the Baltic TSOs is not harmonised:* each TSO proposes a custom mFRR product bid in terms of minimum order size, activation time and pricing.
- *Imbalance settlement differs between the Baltic countries in many respects:* A different number of balance portfolios (consumption, generation and cross-border) applies for BRPs within the Baltics, also the imbalance pricing principles are not harmonised between countries.

Main differences between the current Baltic and Nordic balancing markets set-up are:

- *No regional balancing market in Baltics:* The Baltic TSOs procure balancing mFRR products according to bilateral agreements (Estonia and Latvia) or from the local balancing market (Lithuania), and the Nordic TSOs procure mFRR products from the regional balancing market.
- *Pricing in Baltic and Nordic balancing markets differs:* For balancing energy pricing the Baltic TSO apply "pay as bid" vs. marginal pricing applied by the Nordic TSOs.

Despite the differences outlined above a number of similarities exist between the Baltic and Nordic balancing markets that may ease mFRR exchange between the Baltic and Nordic power systems.

Similarities of the current practices between the Nordic mFRR market and Baltics:

- Products are activated on the basis of the merit order list;
- Products are offered for both up and down regulation;
- The full activation time of the product is within 15 minutes;
- Products can be used for re-dispatching and counter-trading.

The exchange of balancing energy between the Nordic and the Baltic power systems based on the current mFRR products could be theoretically possible. Product activation time up to 15 minutes and hourly resolution (except for Latvia) should be technically sufficient. Possible option could be that in addition to Estonian bids exchange with Finland also to include the bids from Latvia and Lithuania. Pricing of balancing energy from mFRR in the Nordics and the Baltics is different, but this can be handled as it is handled today between Estonia and Finland – a bid from other TSO's control area is activated on the basis of price (in case there are no technical limitations), but paid in accordance with the local settlement arrangements (marginal price in case of Nordic bids and pay as bid in case of Baltic bids).

However, current balancing market set-up differences and lack of harmonisation between the Baltic mFRR-markets and between the Baltics and Nordics hinder an efficient co-operation for mFRR exchange between the Nordic and Baltic power systems.

Following measures shall be addressed to increase the compatibility of the Baltic mFRR markets with the Nordic and to enable the efficient co-operation in mFRR exchange:

- The Baltic TSOs should take more clear role in balancing power systems in Baltics, i.e. to the extent it is practically achievable local market participants (in Lithuania and Latvia) should be excluded from being open balancing providers to the TSOs;
- Common Baltic balancing energy (mFRR) market shall be created;
- Pricing of TSO – TSO exchanged balancing energy shall be harmonised across the Baltics and shall be based on the marginal pricing (currently applied in Nordic balancing market and also outlined by Network Code on Electricity Balancing as target balancing energy pricing method for pan-European balancing market);
- mFRR product definition shall be harmonised between the Baltic TSOs and towards Nordic mFRR product;
- Balancing principles and pricing shall lead that imbalance prices shall be less advantageous to BRP than day-ahead and (in general) intraday market prices.

Considering the limitations of the current set – up of separate Baltic balancing markets, study WG proposes to proceed with balancing market development to create common Baltic balancing market for the efficient balancing energy exchange within Baltic power systems and with Nordic power systems.

17. Conclusions and recommendations on common Baltic imbalance settlement perspectives

Current Baltic balancing market set-up enables local market participants to be open balance providers that supplies imbalance energy for Baltic TSOs.

The current setup brings following drawbacks:

- Baltic TSOs have higher balancing costs, as current open balance providers gain from the non-existent imbalance netting between the Baltic power systems;
- Current Baltic power systems' balancing set-up is an obstacle for the integration of the Baltic balancing markets;
- Current open balance providers operating in Latvia and Lithuania gain an advantage over other market participants and gain financial benefit from internal Baltic imbalances.

Considering the drawbacks of the current balancing setup of Baltic power systems it is reasonable that imbalance netting between the Baltic TSOs shall be applied:

- Baltic TSOs shall apply common methodology for the imbalance calculation and netting within the Baltic power systems;
- Netted imbalances of the Baltic power systems should be traded and settled between the Baltic TSOs;
- Not netted Baltic imbalances shall be traded with one nominated Baltic TSO which in turn shall trade the total Baltic not netted imbalance with an Open balance provider.

Introduction of imbalance netting between Baltic TSOs shall create conditions for further integration and harmonization of Baltic balancing markets and is in line with requirements of Electricity Balancing Network code to establish Coordinated Balancing Area for Imbalance netting.

Imbalance energy calculation and pricing:

Imbalance netting principles shall be based on equal and non-discriminatory principles, while reflecting the actual impact of imbalance of particular Balance area to the total imbalance of the Baltic area.

As long as Baltic balancing markets are not integrated, following solution for imbalance netting within Baltic power systems shall apply:

- The selling and purchase prices for Netted imbalance shall be equal to average Elspot prices of Estonian, Latvian and Lithuanian bidding areas.
- The selling and purchase price of Not netted imbalance shall be equal to the price of open supply balance energy that is traded by nominated Baltic TSO with open balance provider.

17.1. Conclusions and recommendations on perspective TSO-TSO imbalance settlement within the Baltic systems and actions needed to harmonise imbalance pricing and settlement principles within Baltics and towards Nordic system principles:

Target model for imbalance settlement within the Baltic region provides that there is established common methodology for imbalance calculation and netting within the Baltic power systems.

One of the Baltic TSO would be nominated and responsible for gathering data, calculating the imbalance volumes and prices and providing reports for the Baltic TSOs.

Common methodology for imbalance calculation and netting should be developed within the Baltic power systems, which also, for perspective harmonization reasons, should take into account principles based on Network Code on Electricity Balancing requirements and also principles used in Nordic TSO-TSO balance settlement system (eSett), where appropriate and feasible. This could include:

- marginal pricing for balancing energy deliveries;
- netting of imbalances between Balance areas;
- selling and purchase price of Netted imbalance – average Elspot price;
- selling and purchase price of Not netted imbalance – based on Opens Supply Price.

Considering the perspective Baltic – Nordic balancing market integration and creation of level playing field for market participants within the integrated Baltic – Nordic region, the TSO - BRP imbalance pricing should be harmonized in Baltics. For this, in addition to the TSO – TSO balance settlement principles listed above, Nordic principles of TSO - BRP imbalance energy pricing should be considered.

However, application of different TSO – BRP imbalance pricing models inside every power system does not hinder exchange of balancing energy between the power systems. Also, changes of the TSO – BRP imbalance pricing model would need further discussions with national market participants and Regulators by each TSO that shall consider power system security and socio-economic gain as base for introduction of different TSO–BRP imbalance pricing model.

18. Conclusions and recommendations on the possibilities to harmonize balancing energy exchange from mFRR within the Baltics and with the Nordics

18.1. Conclusions and recommendations on the target model of the common Baltic market for balancing energy from mFRR:

Target model for Baltic common balancing market shall be based on the principle of common Baltic imbalance netting and settlement towards Russia/Belarus.

Balancing principles and pricing shall lead that imbalance prices shall be less advantageous to BRPs than day-ahead and intraday market prices.

Following are the key principles for the common Baltic market for balancing energy from mFRR:

- A common TSO-TSO settlement for power system's imbalance energy (area control error, - hereinafter ACE) shall be in place;
- Activation of mFRR within Baltics shall be based on the total Baltic ACE and the algorithm applied for the optimisation of balancing energy bids activation must be commonly developed;
- There should be a common Baltic merit order list for upward and for downward balancing energy bids and activation of mFRR within the Baltic States shall be based on the most advantageous price criteria (merit order) of technically available mFRR bids within the Baltics, Nordic mFRR bids available for the Baltic and Nordic TSOs, unless congestion at cross-border or in the internal grid is present;
- Each TSO shall receive balancing bids from BSPs in their own balance area and submit the offers to other TSOs or to the common IT platform;
- One of the Baltic TSOs shall initiate actions for activation of the balancing bids to balance common Baltic ACE;
- The TSOs shall act jointly as one single buyer in the Baltic balancing market and cooperate in selecting the offers to use. Whenever an offer is selected, responsibility for ordering the BSP to activate the service shall be delegated to the local TSO;

- Until the creation of the common Baltic-Nordic merit order list (or some common agreement regarding exchange of balancing bids), the Nordics offers can be ordered and settled only by connected TSO-TSO method.

18.2. Conclusions and recommendations on the Baltic mFRR standard product for the balancing energy exchange:

Considering the current Baltic balancing practices it may be concluded that all technical requirements for the Baltic mFRR standard product can be harmonized with the Nordic standard product. It is important to note that according to the Network Code on Electricity Balancing requirements the pan-European standard product(s) shall be defined by all TSOs, therefore the Baltic and Nordic mFRR standard product(s) in future should be in line with the pan-European standard products defined by TSOs.

Thus the proposal for the definition of Baltic standard mFRR product is based on the definitions and requirements for the standard products by Network Code on Electricity Balancing.

Following figure contains overview of the standard balancing product based Network Code on Electricity Balancing.

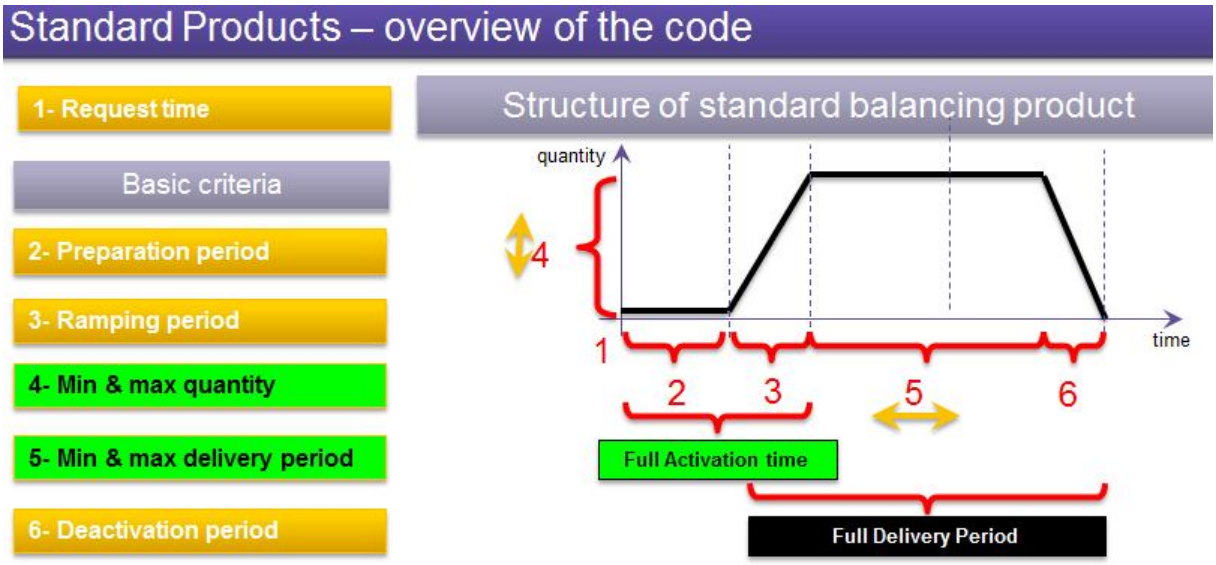

Figure 19: Standard balancing products based on Network Code on Electricity Balancing requirements.

Considering the aim to ease the cooperation between the Baltics and the Nordics in balancing energy exchange the following table contains a proposal for the Baltic standard mFRR product based on features of the current Nordic standard mFRR product and taking into account Network Code on Electricity Balancing requirements for the harmonised pan European Balancing product(s) yet to be defined by all TSOs.

Table 16: Proposal for the standard Baltic mFRR product.

Standard Products	**The proposal of definition of Baltic mFRR standard products to be exchanged**
Preparation Period (2)	Agreed during the phone call
Ramping Period (3)	<15 min
Full Activation Time (2 + 3)	15 min
Minimum and maximum quantity (4)	MIN = 5 MW MAX = no restrictions
Deactivation Period (6)	< 15 min
Pricing Method	Marginal price
Divisibility	Offers are divisible
Minimum and maximum duration of Delivery Period (5)	MIN = 1 min; MAX = 60 min (but not more than until the end of operational hour).
Validity Period (at least 3+5+6)	60 min
Mode of Activation	Manual
Minimum duration between the end of Deactivation Period and the following activation.	Not determined

Settlement volume determination: Start end time of the order (3 + 5 + 6)	5
Gate closure of the offers	H-45min
Firmness of the offers	All received offers are firm (fixed). Market participant has responsibility to inform TSO if there are unplanned technical restrictions to execute the offer after the Gate closure but not later than exact order.

In addition to recommendations regarding key principles for the target model for the common Baltic mFRR market outlined in section 8 of this study, the developed technical activation process must take into account technical constraints and operational security issues.

18.3. Conclusions and recommendations regarding settlement rules for target model of the common Baltic market for balancing energy from mFRR:

Target model structure for the Baltic balancing market with common Baltic ACE (imbalance) balancing shall contain marginal price settlement of TSO-TSO balancing deliveries, and settlement of the remaining Baltic Common Balancing Area (CoBA) ACE shall be as follows:

- The price of netted imbalance shall be based on average day – ahead (Elspot) prices of Baltic's bidding area.
- The price of not-netted imbalance shall be based on the price of open balance supply.

Following shall apply to the marginal pricing method for balancing deliveries:

- When the delivery hour has passed, the price of the most expensive up regulation offer, which has been activated in the balancing market becomes the up regulating price, which is the price paid to all activated up regulation offers;
- Similarly, the lowest activated down regulation bid defines the down regulation price, which is paid to all activated down regulation offers;
- If there were both up and down balancing during the hour, the dominating direction shall determine whether it is an up- or down-regulation hour.

The proposed marginal price mechanism shall stimulate Balance Service Providers (BSP) to submit reasonable offers, also the marginal pricing supports equally cost-based settlement between TSO-TSO.

According to the proposed pricing method, when there shall be no congestion the balancing price shall be the same for the whole Baltic region. In the presence of congestion the region shall be split into smaller areas and there shall be different balancing prices for each area (and also different imbalance prices). Bids used for special regulation (such as countertrading) shall not be allowed to influence the balancing price for the hour.

Following are study recommendations regarding settlement of balancing energy deliveries between TSOs – BSP, and between TSOs:

- **Settlement of balancing energy with BSP**
  - Each TSO shall settle the activated volume of balancing energy with the BSP located in respective TSO's balance area;
  - Each TSO shall calculate the activated volume of balancing energy to be used as an imbalance adjustment, and apply the volume to the concerned BSP's balance report;
  - The price of the balancing energy procured or sold by TSOs from/to BSPs and/or other TSOs shall set the price for the imbalance energy traded between TSOs and BRPs.
- **Settlement of balancing energy between TSOs**
  - The settlement of balancing energy between Baltic TSOs shall be handled in the same way as the common imbalance settlement, i.e. by using the Settlement Coordinator function;
  - As the connected TSO is responsible for settlement with the BSP located in respective TSO's balance area, then TSO-TSO settlement reports for each Party shall be organised by the Baltic Settlement Coordinator with purpose to ensure equal cost sharing between Baltic TSOs.

18.4. Conclusions and recommendations on the needed technical IT implementation for the common Baltic market for balancing energy from mFRR:

Current IT tools of Baltic TSOs are mostly based on local needs and includes some cooperation between Baltic TSOs in accordance with bilateral agreements. Operation of common Baltic mFRR market requires establishment of common IT tools for the Baltic TSOs to execute the processes for submission of bids, activation and settlement.

Development of the Baltic common IT tools for operating the Baltic mFRR market can be arranged in two ways:

1. Common IT process. Baltic TSOs can update the existing IT systems and establish common data exchange and coordination process. Thus all planning, real time and settlement data would be exchanged between separate IT systems and processes in accordance with agreed requirements.

2. Common IT platform. New IT platform can be developed to provide one common tool to be used by Baltic TSOs to manage Baltic mFRR market. Thus, all required information from local IT systems should be provided to common IT platform and all processes should be integrated between local IT systems and common IT platform.

Common IT platform should be considered as more efficient solution considering easier implementation of other common processes between Baltic TSOs that will be required by network codes, also better integrations possibilities with other common platforms.

There are at least three possible options how to enable communication between the Nordic Operational Information System (NOIS) and Baltic TSOs to enable mFRR exchange.

1. To establish communication link between NOIS and foreseen common Baltic platform;

2. To use mFRR section of NOIS. This option would be based on granting access to mFRR section for the Baltic TSOs;

3. To grant full access to NOIS for Baltic TSOs.

Options 2 and 3 would most likely need further system development for NOIS. Further development plans how to implement and operate communication between NOIS and common Baltic platform shall need to be coordinated with the Nordic NOIS System Group.

18.5. Conclusions and recommendations on the key elements to take into account to ease the co-operation between the Baltic and Nordic mFFR markets:

The key elements to take into account to ease the co-operation between the Baltic and Nordic mFFR markets are:

- Creation of Coordinated Balancing Area in Baltics.
- Creation of common Baltic mFRR balancing market.
- Agree on and implement common Nordic – Baltic mFRR product(s).

- Creation of cooperation model to minimise balancing costs in the Nordic-Baltic region.

Also the procedures and principles for the balancing energy exchange through HVDC links connecting Nordic and Baltic countries shall need to be harmonised.

Baltic and Nordic TSOs also shall need to agree on the process of integration of Baltic – Nordic balancing markets step by step and different steps shall be tested during the process.

Annexes to the study

Annex 1. The current practices with mFRR in the Baltics and Nordic countries

1) Procurement Scheme

Country	What is the balancing process in place?	Procurement scheme	Comments
Estonia	Self-Dispatch - Unit Based	Free Offers	Pre-contracted reserves are fast disturbance reserves which are used only in case of emergency
Latvia	Self-Dispatch - Unit Based	Free Offers	
Lithuania	Self-Dispatch - Unit Based	Free Offers	
Finland	Self-Dispatch - Portfolio Based	Market	The fast disturbance reserves are offered to the RPM as a volume bid. They are activated after the commercial bids with a price of the highest commercial bid.
Sweden	Self-Dispatch - Portfolio Based	Market	SvK manages the fast disturbance reserves in the same way as Fingrid. However, unlike in Finland, when activated their pre-fixed price can set the RPM price.
Denmark	Self-Dispatch - Portfolio Based	Market	
Norway	Self-Dispatch - Unit Based	Market	The pre-contracted bids are used in the same way as ordinary bids on the RPM list.

2) mFFR Providers

Country	mFRR provider	Comments
Estonia	Generators Only	
Latvia	Generators Only	
Lithuania	Generators + Pump Storage units pumping	
Finland	Generators + Load	
Sweden	Generators + Load	
Denmark	Generators + Load	
Norway	Generators + Load	

NC requirement	Standard Products for Balancing Capacity and Standard Products for Balancing Energy shall: (b) allow the participation of load entities, energy storage facilities and generation, including renewables sources and aggregation facilities as a Balancing Service Provider.

3) Symmetrical Product

Country	Symmetrical product	Comments
Estonia	No	
Latvia	No	
Lithuania	No	
Finland	No	
Sweden	No	
Denmark	No	
Norway	No	

4) Distance to real time of reserve products auctions/ Distance to real time of energy products

Country	Distance to real time of reserve products auctions/ Distance to real time of energy products	Comments
Estonia	N/A	As a rule the product is fully activated within 10 minutes. Usually the command for activation will be given at a moment´s notice, but there is also possibility to activate the product in advance (usually up to 10…15 minutes).
Latvia	N/A	Agreed during telephone call – from 0 to several minutes.
Lithuania	N/A	Time is agreed during the telephone call. Can be from 0 to few minutes.
Finland	15 minutes	The mFRR-bids shall be activated fully within 15 minutes.
Sweden	15 minutes	The mFRR-bids shall be activated fully within 15 minutes.
Denmark	15 minutes	The mFRR-bids shall be activated fully within 15 minutes.
Norway	15 minutes	The mFRR-bids shall be activated fully within 15 minutes.

5) Product Resolution in MW and in Time

Country	Product resolution in MW	Product resolution in time	Comments
Estonia	No minimum bid size	Hour	Minimum step size is 1 MW.
Latvia	No minimum bid size	< 15 minutes	
Lithuania	≥5 MW	Hour	Minimum step size is 1 MW.
Finland	≥ 10 MW	Hour	
Sweden	≥ 10 MW (SE4:≥5 MW)	Hour	
Denmark	≥ 10 MW	Hour	
Norway	≥ 10 MW	Hour	

6) Minimum Delivery Period for Standardised mFRR

Country	Minimum delivery period in time	Comments
Estonia	No formal requirement	In practice it is 1 minute
Latvia	Different durations for the different products: 15 min, 30 min, 45 min, 60 min.	
Lithuania	No formal requirement	In practice it is 1 minute
Finland	No formal rule, in practise 1 minute.	
Sweden	No formal rule, in practise 1 minute.	
Denmark	No formal rule, in practise 1 minute.	
Norway	No formal rule, in practise 1 minute.	

7) mFRR Activation Rule and Monitoring

Country	Activation rule	Monitoring	Comments
Estonia	Merit order	Hybrid	Elering monitors in real-time the capacity and energy in Estonian plants, outside Estonian Power System it is ex-post check
Latvia	Merit order	Real-Time Monitoring	
Lithuania	Merit order	Hybrid	
Finland	Merit order	Real-Time Monitoring	
Sweden	Merit order	Real-Time Monitoring	
Denmark	Merit order	Real-Time Monitoring	
Norway	Merit order	Hybrid	

8) Technical Requirements of the Product

Country	Can offered products be partially activated?	What is the activation time of mFRR from 0 to max?	Can the energy of balancing be used in the redispatching / counter-trading actions?	Comments
Estonia	Yes, in all directions	<=10 min	Yes	Exceptionally the activation time could be within 20 minutes
Latvia	Yes, in all directions	x <=15	Yes	
Lithuania	Yes, in all directions	X <=15	Yes	Market participants provide offers, however these must correspond to max and min power of the unit
Finland	Yes, in all directions	<=15 min	Yes	
Sweden	Yes, in all directions	<=15 min	Yes	
Denmark	Yes, in all directions	<=15 min	Yes	

Norway	Yes, in all directions	<=15 min	Yes	

9) Settlement rule and cost recovery scheme[3]

Country	Settlement rule	Cost recovery scheme	Comments
Estonia	Pay as bid	100% BRP	
Latvia	Pay as bid	100% BRP	
Lithuania	Pay as bid	100% BRP	Maximum price for local market participants upward direction is set 203 EUR/MWh.
Finland	Marginal Pricing	100% BRP	
Sweden	Marginal Pricing	100% BRP	
Denmark	Marginal Pricing	100% BRP	
Norway	Marginal Pricing	100% BRP	

10) Transfer[1]

Country	Does your TSO allow for transfer of obligation?	In case transfer obligation is allowed, is there an organised secondary market?	Comments
Estonia	No	N/A	
Latvia	No	N/A	
Lithuania	No	N/A	
Finland	No	N/A	
Sweden	No	N/A	
Denmark	No	N/A	
Norway	No	N/A	

11) Definitions:

Activation rule *– How the frequency restoration reserves are activated i.e. by a Pro-Rata system or on the basis of a Merit Order (cheapest being activated first).*

Distance to real time of energy products (reserve products activation) *– The time ahead from real time when TSO activates a given product (for instance 15 minutes in the case of mFRR/tertiary energy).*

Distance to real time of reserve products auctions *– The time ahead from real time when auction/agreement for an specific balancing product takes place (for instance = 1 year in the case of a reserve agreement signed 1 year ahead of real time).*

Ex-post check *– When the monitoring of performance of plant carried out after the event.*

Free offers *– Non-regulated offers.*

Hybrid *– Combination of real-time monitoring and ex-post check.*

Market *- There is no contract or obligation for a grid user to offer the energy (before the offer). The grid user can voluntary participate in the real-time energy market and bid a price or customize his offer (e.g. the volume, timeframe).*

Merit order *– A merit order is a way of ranking available sources of energy in ascending order of their short run marginal costs of production, so that those with the lowest marginal costs are the first ones to be brought online to meet demand.*

Monitoring – *Refers to the type of monitoring in place by the TSO to ensure performance of plant.*

Procurement scheme – *Background of the offer, which is closest to the real operation time.*

Product Resolution *– The minimum bid size into the balancing market.*

Product Resolution (in time) *– The maximum resolution for which the product can be bid into the market (for instance =1 hour in the case of a 24 auctions day ahead market for reserve provision).*

Pro-rata *– In Proportion (Parallel Activation).*

Real-time monitoring *– Monitoring of delivery of ancillary services in real time.*

Self-Dispatch - Portfolio Based – *A portfolio of units/generators (or other plant types) follow an aggregated schedule of actions to start/stop/increase output/decrease output in real time.*

Self-Dispatch - Unit Based – *Generators (or other plant types) following their own schedules of actions to start/stop/increase output/decrease output in real time.*

Symmetrical product *– Upward regulation volume and for downward regulation volume has be equal.*

Settlement Rules *– The pricing rules for settlement.*

Pay as bid *– Contracted parties who provide a service are paid based on their offer price.*

Marginal pricing *– Marginal pricing is the change in total cost that arises when the quantity produced changes by one unit.*

Regulated price *– Price for this service is based on a price that is set by the relevant regulatory authority.*

Cost recovery scheme *– From whom are the costs recovered.*

Grid User *– The natural or legal person supplying to, or being supplied with active and/or reactive power by a TSO or DSO.*

Balance Responsible Party (BRP) *– Balancing Responsible Party means a market participant or its chosen representative responsible for its Imbalances.*

Annex 2. Imbalance energy settlement and pricing principles within Baltic and Nordic countries

1) Number of Imbalance Portfolios and Prices

Country	Number of Imbalance Portfolios	Number of Prices			Comments
		1 portfolio			
		2 portfolios/ generation	2 portfolios/ consumption		
		3 portfolios/ generation	3 portfolios/ consumption	3 portfolios / cross-border trade	
Estonia	1	Dual pricing			
Latvia	1	Dual pricing			
Lithuania	3	Dual pricing	Dual pricing	Dual pricing	
Finland	2	Dual pricing	Single pricing		
Sweden	2	Dual pricing	Single pricing		
Denmark	>2	Dual pricing	Single pricing		
Norway	2	Dual pricing	Single pricing		

2) Settlement party, Settlement Time Unit

Country	Party / Time	Settlement Party and Time Unit			Comments
		1 portfolio			
		2 portfolios/	2 portfolios/ consumption		

		generation 3 portfolios/ generation	3 portfolios/ consumption	3 portfolios / cross-border trade	
Estonia	Party	BRP			
	Time	1 hour			
Latvia	Party	BRP			
	Time	1 hour			
Lithuania	Party	BRP	BRP	BRP	
	Time	1 hour	1 hour	1 hour	
Finland	Party	BRP	BRP		
	Time	1 hour	1 hour		
Sweden	Party	BRP	BRP		
	Time	1 hour	1 hour		
Denmark	Party	PRP	CRP		
	Time	1 hour	1 hour		
Norway	Party	BRP	BRP		
	Time	1 hour	1 hour		

3) Time Periods

Country	Publication Time period	Complaint Time period	Time before BRP to carry out re-schedule	Intra Day Market time period	Comments
Estonia	<= 1 week after delivery	9 < x < 12 weeks	50 min	1 hour	
Latvia	> 1 week after delivery	> 12 weeks	45 min.	1 hour	
Lithuania	8th working day of the	2days.	40 min.	1 hour	Settlement data must be

	next month				finalized no later than 10th working day of the next month
Finland	< 1 day after delivery	3 < x < 6 weeks	1 hour	1 hour	
Sweden	< 1 day after delivery	3 < x < 6 weeks	1 hour	1 hour	
Denmark	<= 1 day after delivery	<= 3 weeks	45 min.	1 hour	
Norway	< 1 day after delivery	<= 3 weeks	1 hour	1 hour	

4) Control Energy Prices included in Imbalance Charges

Country	FCR	aFRR	mFRR	RR	Start/ Stop costs	Comments
Estonia			Yes	No	No	
Latvia			Yes	Yes	No	
Lithuania			Yes	Yes	No	
Finland	No	No	Yes		Yes	
Sweden	No	No	Yes		Yes	
Denmark	No	No	Yes		No	
Norway	No	No	Yes		No	

5) Nature of Balancing Obligations and Examptions

Country	Nature of balancing obligation	Exemptions	Limit of Exemption	Comments
Estonia	Legal+financial			

Latvia	Financial only	RES	No	
Lithuania	Legal+financial	RES	No	
Finland	Legal+financial			
Sweden	Legal+financial			
Denmark	Financial only	RES		
Norway	Legal+financial			

6) Market information regarding Balancing volumes and pricing

Country	Description of market information published by each TSO	Timeframe information is published	Comments
Estonia	Published by TSO for each trading hour: - System imbalance - Balancing volumes - Regulating deliveries as system service - Imbalance prices - Planned consumption, generation, CB flows - Actual consumption, generation, CB flows Monthly based electricity balance for trade, physical balance and imbalance settlement.	D+1 D+1 D+1 D+2 D-1 and H-1 H+1 M+15	
Latvia	Planned consumption, generation, CB flows Actual consumption, generation, CB flows Regulating deliveries Imbalance price monthly based for	D-1 (H-1) H+1 D+1	

	every hopu	10th business day M+1	
Lithuania	Information about activated bids of mFRR (average price and total volume)for the previous day	D+1	
	Imbalance price	8th business day of the next month	
Finland, Sweden, Denmark, Norway	Published by Nord Pool Spot per bidding area - Regulating prices - Regulating volumes - Volume of regulating bids - Price up, price down, dominating direction, imbalance price consumption, imbalance price production purchase, imbalance price production sale, volume up volume down The TSOs publish additional information on their own web pages.	H+1 H+1 Available bids for the whole day, updated hourly H+1	

7) Definitions:

Imbalance - *An energy volume calculated for a Balance Responsible Party and representing the difference between the Allocated Volume attributed to that Balance Responsible Party, and the final Position of that Balance Responsible Party and any Imbalance Adjustment applied to that Balance Responsible Party, within a given Imbalance Settlement Period.*

Imbalance Adjustment - *An energy volume representing the Balancing Energy from a Balancing Service Provider and applied by the Connecting TSO for an Imbalance Settlement Period to the concerned Balance Responsible Parties, for the calculation of the Imbalance of these Balance Responsible Parties.*

Imbalance Area - *The Imbalance Price Area or a part of an Imbalance Price Area, for the calculation of an Imbalance.*

Imbalance Price - *The price in each Imbalance Settlement Period for an Imbalance in each direction.*

Imbalance Price Area - *Either a Bidding Zone, part of a Bidding Zone or a combination of several Bidding Zones, to be defined by each TSO, for the purpose of calculation of Imbalance Prices.*

Imbalance Settlement - *Imbalance Settlement means a financial settlement mechanism aiming at charging or paying Balance Responsible Parties for their Imbalances.*

Imbalance Settlement Period - *Time units for which Balance Responsible Parties` Imbalance is calculated.*

Imbalance Settlement Price - *Price in each settlement period for the negative and the positive imbalance. Negative imbalance is defined as the one in which the real generation is lower than scheduled or real consumption is greater than scheduled. Positive imbalance is defined as the one in which the real generation is greater than scheduled or real consumption is lower than scheduled.*

Imbalance Settlement Responsible - *A party that is responsible for settlement of the difference between the contracted quantities and the realised quantities of energy products for the Balance Responsible Parties in a Market Balance Area.*

Imbalance Volume - *Imbalance Volume means the difference between the Position of a Balance Responsible Party and the Allocated Volume of all injections and withdrawals covered by this Balance Responsible Party within a given Imbalance Settlement Period.*

Imbalances - *Imbalances means deviations between generation, consumption and commercial transactions of a Balance Responsible Party within a given Imbalance Settlement Period.*

Imbalance Netting Power - *Imbalance Netting Power means Power which is exchanged via Virtual Tie-Lines and/or HVDC interconnectors between Control Areas in order to perform the Imbalance Netting Process.*

Imbalance Netting Power Interchange - *Imbalance Netting Power Interchange means the power which is interchanged between LFC Areas within the Imbalance Netting Process.*

Imbalance Netting Process - *Imbalance Netting Process means a process agreed between TSOs of two or more LFC Areas within one or more than one Synchronous Areas that allows for avoidance of simultaneous FRR activation in opposite directions by taking into account the respective FRCEs as well as activated FRR and correcting the input of the involved FRPs accordingly.*

Imbalance Netting Process Function - *The role to operate the algorithm applied for operating the Imbalance Netting Process.*

Annex 3. Relevant NC rules regarding mFRR exchange

According to NC on EB rules

Article 10:

All TSOs of a Coordinated Balancing Area shall use the Exchange of Balancing Energy from at least one Standard Product or operating the Imbalance Netting Process.

All TSOs of a Coordinated Balancing Area shall develop a common proposal for a Coordinated Balancing Area, detailing:

(a) the framework for the establishment of the terms and conditions related to Balancing pursuant to Article 26;

(b) the Balancing Energy Gate Closure Time for each Standard Product for Balancing Energy pursuant Article 31;

(c) the TSO Energy Bid Submission Gate Closure Time pursuant to Article 39(11);

(d) the minimum available volumes of Balancing Energy bids;

(e) the Common Merit Order Lists to be organised by the common Activation Optimisation Function pursuant to Article 40;

(f) the principles for the algorithms to be applied pursuant to Article 65;

(g) others: if applicable …

Article 14:

The regional integration model for the Exchange of Balancing Energy for mFRR shall be based on:

(a) a multilateral TSO-TSO Model with Common Merit Order Lists;

(b) more than one Coordinated Balancing Area; and

(c) sharing and exchanging of all Balancing Energy bids for mFRR pursuant to Article 28, except unshared bids pursuant to Article 39(10).

*No later than **two years** after the entry into force of this Network Code, all TSOs commonly develop a proposal for an implementation framework to implement the regional integration model for the Exchange of Balancing Energy for Frequency Restoration Reserves with manual activation.*

The implementation framework pursuant shall include:

a) *a list of TSOs to whom the implementation of the regional integration model for the Exchange of Balancing Energy for mFRR applies;*

b) *a configuration of the Coordinated Balancing Areas for the implementation of the regional integration model for the Exchange of Balancing Energy for mFRR;*

c) *implementation timeline of the regional integration model; and*

d) *high-level principles for algorithms and methodologies used.*

Article 28:

*No later than **one year** after entry into force of this Network Code, all TSOs shall develop a proposal for Standard Products for Balancing Capacity and Standard Products for Balancing Energy.*

All TSOs shall submit the proposals to define, review or update Standard Products for Balancing Capacity and Standard Products for Balancing Energy to all NRAs for approval. The proposal shall at the same time be submitted to the Agency for information.

Article 31:

All TSOs of a Coordinated Balancing Area shall commonly define and agree on Balancing Energy Gate Closure Times. The Balancing Energy Gate Closure Time shall be defined for each Standard Product for Balancing Energy per Coordinated Balancing Area.

After the Balancing Energy Gate Closure Time the update of a Balancing Energy bid for a Standard Product in a Coordinated Balancing Area is no longer permitted. After this time the volume and price of Balancing Energy bids can only be changed with approval of all TSOs of the concerned Coordinated Balancing Area.

Article 38:

*No later than **one year** after the entry into force of this Network Code, all TSOs shall develop a proposal for the pricing methods of each Standard Product for Balancing Energy. The pricing methods shall be based on marginal pricing (pay-as-cleared), unless TSOs complement the proposal with a detailed analysis*

demonstrating that a different pricing method is more efficient for European-wide implementation in pursuing the general objectives defined in Article 9.

Article 39:

No later than **twelve months** after the entry into force of this Network Code, all TSOs shall commonly develop and agree on a methodology regarding the activation purposes of Balancing Energy bids in line with the general objectives of the Balancing Market pursuant to Article 9.

The activation of Balancing Energy bids shall be based on a TSO-TSO Model.