Joint TSO-DSO Flexibility Market for Congestion Management

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***Abstract*—As the need for flexibility is increasing, new congestion management methods are needed by system operators. Although several previous studies have presented the concept of a joint TSO-DSO congestion management market, there is still a lack of practical experiences. This paper presents how a joint TSO-DSO congestion management market is designed, set-up, and to be used operationally in Finland for the first time. The paper also describes the requirements for the flexibility service providers, which are designed to be easier to fulfil compared to the balancing markets to reach especially such flexible resources that do not yet offer flexibility. The proposed product structure of a joint TSO-DSO congestion management market comprises a capacity market auction opened based on the system operator's need and an energy market based on an auction and continuous trading.**

***Index Terms*—flexibility market, congestion management, energy product, capacity product, TSO-DSO coordination**

I. Introduction

As the energy transition progresses, the need for flexibility in the electricity system is increasing and new mechanisms for congestion management need to be developed by transmission and distribution system operators (TSOs and DSOs) in Europe. The increased need for congestion management methods has been also experienced in Finland by the SOs. Finland is one bidding zone in the day-ahead market covering a large geographical area. Fingrid Oyj, the TSO in Finland, operates the meshed 400 kV, 220 kV and 110 kV transmission system. In Finland, 77 DSOs [1] are operating distribution grids. The Finnish power system has interconnections to Sweden, Norway and Estonia. Large amount of generation capacity is in the northern and central Finland while most of the consumption is in the southern Finland. Especially, the amount of wind power capacity has increased rapidly in the west-coast of Finland during the past few years. Simultaneously, in the south, several fossil-fuel based generation and combined heat and power plants (CHP) are decommissioned, and the consumption is expected to drastically increase. New load types such as electric boilers, data centers, and hydrogen production units are being connected to the grid. There is an increasing need to transfer electricity from northern and central to southern Finland. New grid investments are needed to ensure that the power system meets the requirements of the changing operational environment [2]-[3]. In addition to the new grid investments and other congestion management mechanisms already in use, novel congestion management mechanisms are required.

To develop new mechanisms, Fingrid Oyj, the TSO in Finland, and Helen Electricity Network Ltd. (later referred to as Helen DSO), the DSO in Helsinki, have started a project to set-up a joint TSO-DSO congestion management market for the first time in Finland. The purpose of the project is to get practical experience on 1) the functionalities of an operational flexibility market for congestion management and the suitability of the defined market rules, 2) the processes needed by the system operators (SOs) to utilize the market, 3) the market participation of flexibility service providers (FSPs) and the characteristics of the flexible resources, 4) the liquidity of the market. Although it is a development project, the new market will be used operationally to solve real grid congestions.

Several previous studies [4]-[7] and EU-funded R&D projects such as OneNet, Interrface, SmartNet, CoordiNet, and EU-SysFlex have studied, simulated or demonstrated in small-scale flexibility markets including TSO-DSO coordination and/or the concept of a common market. However, there is still a lack of concrete experiences of a joint TSO-DSO market. This paper tackles the research gap between the studies and simulations, and the practical set-up, design and operational use of a joint TSO-DSO market. The paper is structured as follows: Section II introduces congestion management and the project. Section III describes the need for congestion management and the use cases of Fingrid and Helen DSO. Section IV presents a process description of the market. Section V explains the market design, product definitions and requirements for the FSPs. Section VI discusses the background and reasons for the choices done in the product definitions as well as presents future aspects. Section VII summarizes conclusions.

II. Background

A. *Congestion Management Markets in Europe*

Flexibility markets for congestion management are developing in different phases in European countries. One of the most advanced countries in the TSO-DSO congestion

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management market and coordination is the Netherlands, where GOPACS, a tool jointly developed by the TSO and the DSOs, has been in operational use for several years for market-based redispatching [8]-[9]. In Great Britain, several DSOs are using local flexibility markets (LFM) [10]-[11]. National Energy System Operator (NESO, TSO in Great Britain) is trialing a Local Constraint Market (LCM) to help to manage constraints across the Scottish transmission boundaries [12]. Several DSOs in Sweden and Norway have piloted or are piloting LFMs in various projects such as Sthlmflex [13], Effekthandel Väst [14]-[15] and Euroflex [16]. In Belgium, Fluvius (DSO) is trialing procurement of flexibility from a local market [17]. In Portugal, E-REDES (DSO) has tested an LFM in a pilot project [18]. In Italy, E-Distribuzione (DSO) is continuing its LFM pilot project [19], Areti (DSO) is trialing LFM in RomeFlex [20] and Unareti (DSO) in MiNDFlex [21]. In the markets or projects mentioned above, excluding GOPACS, flexibility is procured by either the DSO or the TSO, there is no common TSO-DSO market. Practical experiences of designing, setting up and using a joint TSO-DSO market operationally are still largely missing.

B. *Development project of Fingrid and Helen DSO*

After the preparation phase, the project started with a public procurement process of a commercially available, system-as-a-service trading platform in June 2024 with an aim to go-live during the winter 2024-2025. In the planning phase, the roles of the TSO-DSO coordinator and the flexibility register (FR) are described as separate roles from the market operator (MO). However, in this project, the requirement for the trading platform is to handle the functionalities of the MO, the FR, and the coordinator. During the summer and fall 2024, Fingrid and Helen DSO defined the trading products and market rules to enable a joint TSO-DSO market, and prepared the Terms and Conditions for the Suppliers of the Congestion Management Flexible Capacity and Energy (later referred to as the T&C of the FSPs) and submitted the T&C to the national regulatory authority (NRA) for approval in October 2024. The approval process of the NRA is regulated by Act on the Supervision of the Electricity and Natural Gas Markets [22]. The public consultation on the T&C of the FSPs was held by the NRA in November 2024 [23].

In December 2024, Fingrid and Helen DSO announced that NODES AS has been selected as the provider of the trading platform for the project [24]. The project started with a market set-up phase including training of the SOs and the interested FSPs. In December, the SOs held the first stakeholder meeting (in-person/online) of the project, and ca. 40 potential FSPs participated. After the event, 10 potential FSPs registered to participate in market training in the test environment of the NODES platform. The project was named as "FinFlex – TSO-DSO congestion management market" [25]. The set-up phase was finalized and the capability for go-live was reached in February 2025. However, the approval of the NRA is still pending. In March 2025, after exchanges between the SOs and the NRA on the T&C, the NRA started a public hearing of its decision to approve the T&C [26]. The market go-live is expected immediately after the SOs have received the NRA's approval. The development project ends by the end of 2027.

III. Need for Congestion Management and the Use Cases in the Project

Congestion management mechanisms are needed when generation and consumption are located unevenly across the grid and the need for electricity transmission to or from an area is larger than the transmission capacity in that area. This section introduces the need for congestion management and the use cases of the TSO and the DSO in this project.

A. *Transmission System Operator – Fingrid*

Congestion management of the TSO, Fingrid, is regulated by the European legislation such as Regulation (EU) 2019/943 [27], the Finnish Electricity Market Act [28], the Regulation of the Ministry of Economic Affairs and Employment [29], and grid connection terms and agreements of Fingrid [30][31]. In addition, Fingrid's Congestion Management Policy [32] presents the main principles applied.

1) Need for congestion management: The congestion management need is case specific. In general, congestions occur rather seldom and infrequently and may be unpredictable, e.g., due to a fault in a main grid component. Time of the year, weather conditions and outdoor temperature, day-ahead electricity market prices, faults, and pre-planned outages of grid components are among the factors that impact the congestion management need (amount, location, direction up/down). The need is expected to be realized quite seldom during the ongoing and the next couple of years in the congestion zones presented in Fig. 1 of the Appendix. However, when the need occurs, it is expected to be from several dozen to several hundred megawatts. The duration of the need is case dependent, typically from a few to several hours. The congestion may be repeated in consecutive days if the impacting factors remain the same. Congestions may also occur quickly during the operating hour. Since the power flow is usually from northern and central to southern Finland, in a typical scenario, up-regulation would be needed in southern Finland.

2) Congestion management mechanisms: Fingrid utilizes several congestion management mechanisms such as technical mechanisms (e.g. grid investments, temporary switching arrangements, dynamic rating of grid components), market-based redispatching and countertrading (e.g. mFRR special regulation [33], countertrading in the intraday market [34]), bilateral contracts [35], flexible connections (for local issues), and generation infeed limitations during pre-planned outages [32]. In this project, the focus is on marketplace-based congestion management and congestions inside the bidding zone of Finland. Fingrid uses the new market as part of other congestion management measures.

3) Use cases and congestion zones in the project: The new market is used to relieve congestions of the 400 kV transmission grid inside the bidding zone of Finland in normal, fault, and disturbance situations in accordance with Fingrid's Congestion Management Policy [32]. The bids of the market are used to operate the 400 kV grid according to the N−1 criterion and the operational security limits. Fingrid will procure flexibility from the defined congestion zones based on its forecasts. The forecasts become more accurate the closer the operating hour gets. In sudden congestions that require fast actions, the TSO utilizes other mechanisms of congestion management since the bids in this market are not targeted to provide fast (in this case, < 60 min) response. The congestion zones of Fingrid, i.e. the procurement areas of flexibility in the congestion management market, presented in Fig. 1 of the Appendix, are based on the relevant 400 kV transmission grid cross-sections.

B. Distribution System Operator – Helen DSO

The operations of DSOs in Finland are regulated by the European legislation such as Regulation (EU) 2019/943 [27] and Directive (EU) 2019/944 [36], and the Finnish Electricity Market Act [28]. The Electricity Market Act [28] states that the DSOs shall, when possible, utilize market-based flexibility services to improve the efficiency of network operation and development as well as for congestion management within the distribution network and between neighboring network areas.

1) Need for congestion management: The regional electricity transmission through the Helen DSO's distribution area from Helsinki's northern border towards the city center in the south is dramatically and rapidly increasing. The change is mainly caused by coal-burning CHP power plants being phased out in favor of electric boilers and industrial heat pumps. This not only introduces new consumption to the grid but also removes the large-scale electricity generation from the area. In Helsinki, the 110 kV sub-transmission grid is operated according to the N−1 criterion. The local 110 kV network may in certain specific moments and switching status face bottlenecks. The flexibility needs are expected to seldom arise, usually during winter working days and their late afternoons with duration of a couple of hours.

2) Congestion management mechanisms: The toolbox of congestion management includes manifold means. The traditional solution to enhance transmission capacity is to construct new 110 kV connections. However, these investments take years while immediate measures are needed. Helen DSO has signed first flexible connection agreements with new 110 kV customers. The update of maximum loading limits of 110 kV network components allows higher electricity transmission. The power flow of the local 110 kV network can be managed and the transmission capability through the distribution area increased by implementing new 110 kV current limiting reactors. As a new approach, market-based flexibility will be tested in the project.

3) Use cases and congestion zones in the project: Helen DSO's first use cases will be to manage the bottlenecks of the local 110 kV network caused by the especially high loads in the city downtown and high transmission needs through the local distribution area. The first use cases will be up-regulation bought from the most southern parts of the Helsinki city. Helen DSO runs hourly loading forecasts covering the next two weeks considering the forecasts of weather and day-ahead electricity market prices as well as the switching status of the sub-transmission network. The accuracy of these forecasts is improving towards the start of the operational hour. These forecasts reveal the flexibility needs for the coming days. In addition, as a consequence of a sudden, unpredicted fault and an abnormal switching status, flexibility needs may arise. The congestion zones of Helen DSO (presented in Fig.1 of the Appendix) are formed according to the local 110 kV grid cross-sections.

IV. Process Description

The section presents an overview of the process required for trading on the market in this project. The process described in this section is presented in Fig. 2 of the Appendix.

A. Preparations before trading, trading and delivery

Before being able to trade in the market, the FSP must register to the trading platform, in this project, to the NODES platform. The MO and the SOs check the company details and approve the FSP. After the registration, the FSP is able to add flexible resources for prequalification. The FSP is obliged to inform the balance responsible party (BRP) and the electricity supplier of the flexible resource in the platform, since this information is needed in the imbalance settlement reporting of the trade. The flexible resource is accepted by the SO in which network the resource is connected to. Fingrid and Helen DSO coordinate the approval of the flexible resources connected to the Helen DSO's grid since these can be utilized by both SOs. The SO assigns the flexible resource to a congestion zone, i.e. a procurement area of flexibility, based on the geographical coordinates (used by Fingrid) or the measurement point ID (used by Helen DSO). The congestion zones represent nodes with geographical dimensions and thus form a simplified grid model in which nodes have a hierarchical structure containing parent-child relationships (Fig. 1 of the Appendix). The hierarchy of congestion zones is used in matching buy and sell orders assigned to different congestion zones but also to automatically determine the suitable zones outside the congested zone to procure flexibility to the opposite direction to cancel out the balance impacts of redispatching (Section V.B.2). After the prequalification, the FSP creates flexible resource groups for trading, in this project, based on the BRP and the supplier and the congestion zones of the SOs.

An SO needs to estimate its flexibility need per congestion zone in advance, several weeks and/or days ahead to be able to make decisions in the market. If flexibility need is foreseen to be likely some weeks or months ahead and if necessary, an SO may procure capacity from a capacity auction to guarantee the availability of energy bids. If the capacity auction phase is not deemed necessary, an SO may decide to publish a tentative flexibility need in a congestion zone a few weeks or days before or day-ahead or during intraday. The aim of the tentative information is to encourage FSPs to submit bids for a specific time, zone and direction and to increase liquidity. The publication of a tentative need does not commit an SO to procure flexibility. An SO forecasts the flexibility needs in the congestion zones in the day-ahead and intraday timeframes to make procurement decisions in the energy market. The FSPs submit bids to the energy market. If the FSP has opted to provide its baseline, the FSP submits the baseline of the flexible resource group to the FR, in this project, to the NODES platform. If the FSP has opted to not provide its baseline, the NODES platform calculates the baseline. An SO procures flexibility from the congestion management energy market as explained later in Section V. The FSP should deliver flexibility (up/down regulation) according to the accepted bid.

B. *After delivery: verification, settlement, invoicing*

If the energy trade is done after the gate closure of the DA market, the energy volumes of the trade and ramping are reported to the imbalance settlement (Section V.B.2.) After the delivery, the FSP provides measurement data of the flexible resource group to the FR. In this project, the verification of the delivery is done on the level of flexible resource groups. If the delivered energy of the FSP is lower than the energy volume of the accepted bid, sanctions, such as a reduction of payment, as defined in the T&C of the FSPs, apply. The fulfillment of the obligation to submit energy bids based on the accepted capacity offer is also monitored, and a failure to submit the energy bids results in the reductions of capacity payment. In the case of repeated under-delivery or failure to submit the energy bids as obliged, the MO and/or an SO may ask for additional information and suspend the market participation until the issue has been fixed. In this project, the invoicing between the FSPs and SOs is done monthly and managed by the trading platform.

V. PRODUCT DEFINITION AND REQUIREMENTS

This section presents the product definitions. Details of the products are presented in Fig. 3 and Table 1 of the Appendix.

A. *Capacity Product*

The capacity product is a product that allows SOs to reserve flexible capacity in a capacity market auction to ensure that flexibility is available when it is needed. If the FSPs capacity offer is accepted in the auction, the FSP is obliged to provide corresponding amount of energy bids in the energy market at specific times. In return the FSP receives compensation (capacity payment) for being available, but also if the resulting energy bids are accepted in the energy market (energy payment). When an FSP participates in the capacity market, it submits the price for the capacity (for being available) and the maximum price for the energy bid. The product is useful when an SO foresees a congestion problem a few weeks or months ahead. An SO can then open an auction to the capacity market in which the SO defines the amount of flexibility that is needed, the time window during which FSPs should be available and optionally price caps which indicate the price at which the SO is willing to buy the flexibility. For example, an SO might wish to buy 10 MW of flexibility in January from Monday to Friday between 08:00-13:00 within a congestion zone. FSPs can then choose to offer exactly what was requested or any portion of it. Finally, once the capacity auction has closed, the SO chooses the best offers. The selection principle is based on the capacity and energy price of the FSP's offer and the weighting of the capacity and energy prices as indicated by the SO in the auction. The SO may also choose not to select any capacity offers. The pricing method is pay as bid. In the selected trading platform, this product is called NODES LongFlex™ Auction.

B. *Energy Product*

The energy product has been defined by the SOs Fingrid and Helen DSO, and the detailed technical implementation has been specified with NODES AS. The energy market consists of an auction and a continuous market. In the project, the auction is utilized by the DSO and the continuous market by the TSO. The market time unit (MTU, delivery period) is 60 min. Fig. 3 in the Appendix presents the timeline of the energy market.

1) Auction – Energy market before the gate closure of the day-ahead market: In the energy market, an auction is held at D-1 10:00 EET/EEST for all hours of the next day. The bids that fulfill the needs of the DSO are selected automatically by the trading platform based on the price. The pricing method is pay as bid. In this project, as the auction is held before the gate closure of the day-ahead (DA) market, the energy volumes of the trade are not reported to the imbalance settlement by an SO, i.e., no imbalance corrections are done towards the BRP of the flexible resource group. The BRP and the electricity supplier of the flexible resource group need to take the trade done by the FSP in the auction into account in their trading e.g. in the DA market. After the auction, the unused bids of the FSPs will remain in the market unless the FSP has set an expiry time for the bids to be D-1 at 11 EET/EEST. In the selected trading platform, this product is called NODES ShortFlex™ Auction.

2) Continuous Market – Energy market after the day-ahead market results: In the energy market, the TSO starts to trade after the DA market results at 15:00 EET/EEST. The FSPs can submit bids, and the TSO can purchase flexibility until 60 minutes before the delivery commences (T-60). The FSP can define an expiration time for its bid and thus all bids may no longer be available for the TSO at T-60. The bids that fulfill the needs of the TSO are selected automatically by the trading platform based on the price. The pricing method is pay as bid. In the selected trading platform, this product is called NODES ShortFlex™ Continuous Market. Since the trade is done after the gate closure of the DA market, the energy volumes of the trade, i.e., the delivery period, and the ramping energy volumes before and after the delivery period are reported to imbalance settlement responsible (ISR, eSett Oy in the Nordics). In the project, the trading platform provides an imbalance settlement report containing the energy volumes per imbalance settlement period (ISP, 15 min) and per BRP-supplier. Based on the report, the TSO reports the energy volumes to the ISR as bilateral trades between the TSO and the supplier-BRP. Therefore, the position of the BRP of the flexible resource group is corrected and no imbalance and imbalance costs occur for the BRP due to the trade in the continuous energy market assuming that the FSP provides the flexibility according to the accepted bid and the ramping information it has provided to the platform. No payment is received by the FSP for the ramping energies since the ramping is outside the delivery period of the accepted bid. The FSP can, however, consider the costs of ramping up and down in the pricing of its energy bids. As a basic principle, the TSO procures the same amount of flexibility for congestion management (redispatching) in both directions (up and down, but from different congestion zones) to not impact the balance of the power system. Similar principle is applied in the Netherlands in GOPACS intraday redispatching [37].

C. *Requirements of the FSPs, flexible resources and flexible resource groups*

Participation in the market is voluntary. The requirements are technology-neutral, i.e., all types of generation, consumption and storages can participate. Flexible resources in any location in Finland, excluding Åland, can participate. The minimum bid size is 0.1 MW to enable the participation of small-scale resources. Individual resources can be smaller than 0.1 MW if those can be aggregated to a flexible resource group. In the project, aggregation of the resources to a flexible resource group is allowed if the resources are in the same congestion zone and have the same BRP and the supplier. An FSP may have several flexible resource groups with different BRPs and suppliers. Aggregation is limited to the same BRP and supplier due to the imbalance settlement reporting of the energy trade done after the DA market results. Imbalance settlement reporting (the correction of the BRP's position) is done according to the accepted bid and ramping information of the flexible resource group. If the FSP fails to deliver according to the accepted bid and ramping information, it will result in an imbalance for the BRP of the flexible resource group.

In the resource prequalification, the FSP is obliged by the T&C of the FSPs to bilaterally agree with the BRP and the electricity supplier of the flexible resource on the participation in the market. The FSP is obliged to provide information to the SOs that such agreement exists. The FSP is also obliged to provide new proof if the BRP or the supplier of the resource changes. This process is similar to the process of a contractual balancing service provider in the aFRR and mFRR markets in Finland [38]. For the time being, independent aggregation is not allowed in this market since the model is unfinished in Finland with an ongoing development project to enable independent aggregation in the aFRR and mFRR balancing markets [39]. In addition, a national working group has evaluated the practical implementation of independent aggregation in Finland [40].

VI. Discussion

The SOs may be interested in the same flexible resources at the same time. In this project, the flexible resources located in Helsinki can be used by both SOs, the resources located in other areas in Finland are only used by the TSO. The DSO and the TSO trade in the energy market in different time frames, i.e. the DSO has already done its procurement before the TSO starts trading. In the project, the TSO-DSO coordination is a simple solution, the SOs can view the amount, direction, and congestion zone of the trades done by the other SO. Although, in this project, the DSO will use the auction in the D-1 morning before the DA market gate closure, it is possible that in the future, the DSO would also trade in the continuous energy market after the DA market result. However, the balancing impacts of both the TSO's and the DSO's trades (redispatching) as well as the imbalance settlement reporting of these trades should then be considered, and an efficient solution should be developed. Moreover, to be able to trade in the intraday timeframe, the DSO needs to develop internal trading processes further since the DSOs in Finland do not procure flexibility in any market today and thus, contrary to the TSO, internal processes for trading do not exist in the beginning of the project.

Compared to separate TSO and DSO flexibility markets for congestion management, advantages of a joint market are expected to include increased liquidity due to geographically larger areas and multiple buyers (SOs), and simplicity as the FSPs submit congestion management bids once to a common market. In this project, the congestion management needs of the SOs are expected to be in the same direction, i.e. up-regulation need in southern Finland and in Helsinki. In the future, if a joint TSO-DSO congestion management market would become business-as-usual and several DSOs would participate, the TSO and the DSOs could have congestion management needs at the same time, in the same area but to the opposite direction. TSO-DSO coordination is needed to handle such cases.

The MTU was set to 60 min mainly due to the nature of the SO's congestion management needs. It is possible that the MTU could be shorter in the future as other markets are moving towards 15 min. The T&C of the FSPs are defined based on the needs of the SOs considering the capabilities of the FSPs as well as the market gate closure times (GCT) of other electricity markets (day-ahead, intraday, balancing markets). The auction at D-1 at 10:00 EET/EEST is held after the results of the mFRR [33] and aFRR capacity markets [41]. Since the continuous energy market GCT is 60 min before the delivery, an FSP can still offer the flexibility in mFRR (GCT: T-45 min [33]) or aFRR (GCT: T-25 min [41]) energy markets if its bid was not accepted and the resource fulfills the technical requirements. The SO's have not set any specific ramping time requirements for the flexible resource group. Instead, the SOs ask the FSP to inform the ramp rate (MW/min) to enable the participation of different types of resources, especially such resources that cannot meet the requirements of the balancing markets.

The SOs are constantly gaining experiences during the project and will adjust the T&C of the FSPs if needed. However, any adjustment of the T&C requires a new approval process of the NRA, i.e., fast modifications cannot be done to the requirements, the market rules nor product definitions during the project. The approval process applied for the T&C of the FSPs follows the same national NRA approval process as terms and conditions that come into permanent operational use. No regulatory sandbox or lightened approval process of T&C exists in Finland for SO's R&D projects complicating the market rule creation process and development of a completely new market. The project is followed by Sähkötutkimuspooli, a national stakeholder group coordinated by Finnish Energy that organizes and promotes R&D projects in energy sector. The stakeholder group following this project includes several DSOs in Finland. The experiences of the project can be also used in the future, when the Network Code on Demand Response [42] will be implemented nationally. Moreover, after the project, the experiences of the SOs and the FSPs in this project will be used to decide on the potential establishment of a joint TSO-DSO congestion management market nationally.

VII. Conclusion

The paper presented how a joint TSO-DSO congestion management market is designed, set-up, and to be used in practice in a development project in Finland. The paper presented and discussed the market design of the congestion management market as well as the requirements for the FSPs. The first experiences of the use of the new congestion management market are expected to be received during 2025. As a further work, the results of the operational use of the TSO-DSO market will be analyzed and compared to other flexibility market projects. After experiences are gained in the practical use of the market, recommendations to implement and design an up-scaled and joint TSO-DSO market will be given, and future development needs will be identified.

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APPENDIX

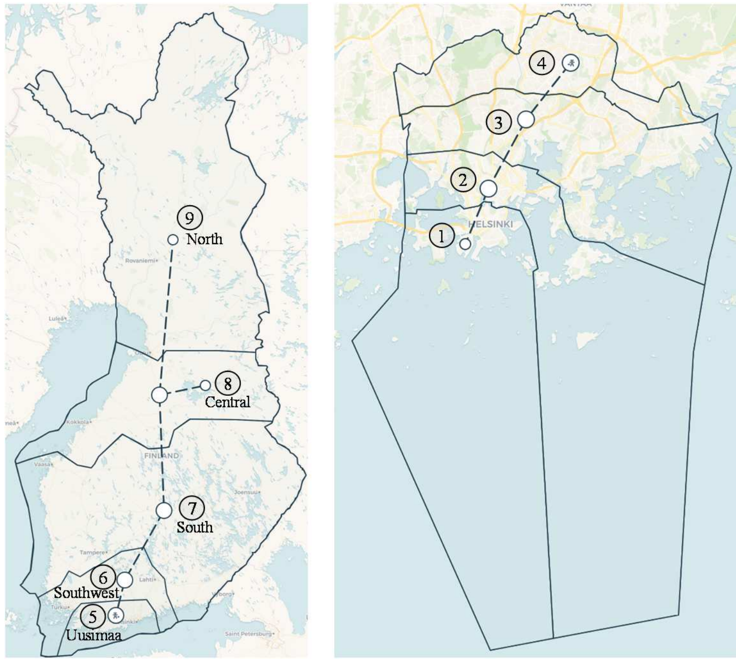

Figure 1. Congestion zones of Fingrid (left) and Helen DSO (right). The top-level node of the grid model is a grid area of Fingrid, i.e. Finland, having three child nodes: no. 7, 8, and 9. Node no. 6 is a child node of no.7. At the lowest level of the grid model of Fingrid is a node no. 5, which is a child node of no. 6. Node no. 5 is connected to the grid area of Helen DSO. The top-level node of Helen DSO is no. 4, and each subsequent node is a child of the previous one, no. 1 being the lowest. Source of the original figures: NODES AS.

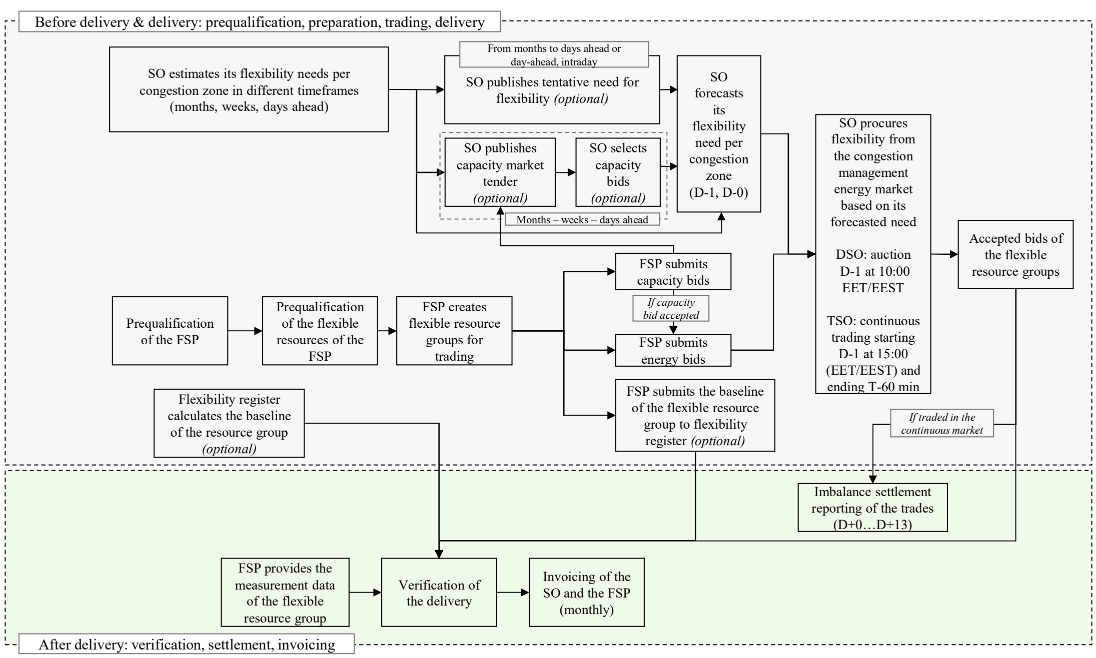

Figure 2. Overview of the process required for trading in the congestion management market from the perspective of the SOs and the FSPs. In the project, the baseline of the flexible resource group can be provided either by the FSP or calculated by the NODES platform. If provided by the FSP, the FSP needs to provide a description of its calculation method to the SO in the prequalification phase. In this project, the FSP provides the measurement data of the flexible resource group to the NODES platform, however, other options, such as utilization of Datahub, are possible in the future.

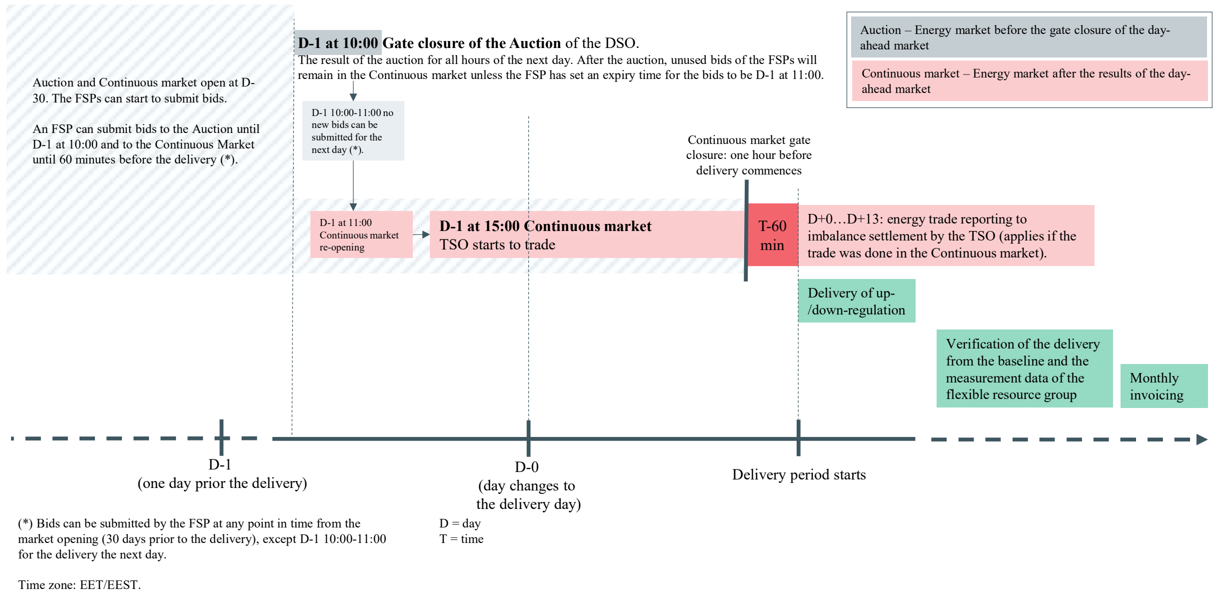

Figure 3. Timeline of the TSO-DSO congestion management energy market.

TABLE I. PARAMETERS OF THE CAPACITY AND ENERGY MARKET

Parameter	*Capacity Market*	*Energy Market*	
	Auction	***Auction***	***Continuous Market***
Trading method	Auction		Continuous trading
Pricing method	Pay as bid		
Market time unit (delivery period)	60 min		
Minimum bid size	0.1 MW		
Gate opening time of the FSP's bids	Informed by the SO separately for each auction	D-30	
Gate closure time of the FSP's bids	Informed by the SO separately for each auction	D-1 at 10:00 EET/EEST	T-60 min
SO energy trading opening and closure times	N/A	D-1 at 10:00 EET/EEST	Opening: D-1 at 15:00 EET/EEST Closure: T-60 min
Delivery profile	N/A	Flat (ramp up and down are not included in the delivery period)	
Ramp up and down rate	N/A	No requirement set by the SOs, the FSP informs ramp rate per flexible resource group (MW/min)	
Other information	If the FSP's offer is accepted in the capacity market auction, the FSP is obliged to bid in the energy market as agreed in the capacity market auction [a]	The FSP can determine rest periods between activations, the minimum and maximum number of activations, as well as the minimum and maximum number of consecutive activations. The FSP can set an expiry time for its bid.	

a. In the project, if the capacity has been procured by Helen DSO, the FSP is obliged to submit bids to the auction of the energy market. If the capacity has been procured by Fingrid, the FSP is obliged to submit bids to the continuous energy market. The obligatory bids compete in the energy market in equal terms with the voluntary bids of the FSPs.