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Abstract

Flexibility markets are recognised as a promising tool to make better use of existing distribution grids and thereby also reduce the need for grid investments. In this paper, we analyse four pioneering projects implementing flexibility markets: Piclo Flex, Enera, GOPACS and NODES. Based on a literature review, we develop a six-question framework and we then analyse the projects with that framework. The questions are: (1) Is the flexibility market integrated in the existing sequence of EU electricity markets; (2) Is the flexibility market operator a third party; (3) Are there reservation payments; (4) Are the products standardised; (5) Is there TSO-DSO cooperation for the organisation of the flexibility market; (6) Is there DSO-DSO cooperation for the organisation of the flexibility market. We find that all the considered flexibility markets are operated by a third party. All projects also engage with multiple DSOs in order to become the standardised platform provider. Important differences between the projects are the extent to which the flexibility markets are integrated into other markets, the use of reservation payments, the use of standardised products and the way TSO-DSO cooperation has been implemented.

Keywords

Market design, flexibility, DSO, flexibility markets, distributed energy resources, redispatch.

1. Introduction*

It is clear that solely relying on grid investments to cope with the increase of load and connections of decentralised generation at the distribution grid will be very expensive. In Europe, flexibility markets are recognised as a tool to make better use of the existing distribution grids and thereby also reduce the need for grid investments. Namely, the newly adopted Clean Energy Package for all Europeans states that distribution system operators shall procure services in a market-based manner from resources such as distributed generation, demand response or storage, when such services are cheaper than grid expansion.[1] Similarly, the Council of European Energy Regulators (CEER) and the respondents to its recent consultation identify market-based procurement as the preferred approach to foster the use of flexibility at the distribution grid (CEER, 2018). Finally, the European Network for Transmission System Operators for Electricity (ENTSO-E) and the major associations for European Distribution System Operators (DSOs) recently published a report in which they emphasise the need for flexibility for grids and lay out possible future active system management techniques needed to unlock this flexibility (ENTSO-E et al., 2019).

Most of the existing literature on flexibility markets is focused on the conceptualization of flexibility markets. In this paper, we go a step further by confronting these concepts with the actual projects that are emerging. First, we do a literature review to identify the main controversies around the design of flexibility markets, which we summarize as six yes/no questions. We illustrate that the same controversies came up in the debate around the design of other electricity markets from wholesale to balancing and re-dispatching markets. Second, we analyse the four pioneering flexibility market projects with our six-question framework. The four projects are Piclo Flex, Enera, GOPACS and NODES.

Note finally that flexibility markets refers to peer-to-peer trading or local markets, as-well-as, to markets that are used by distribution system operators to re-dispatch their grids at distribution level. The projects referred to in this paper also illustrate how both types of trading activities can take place on the same platform. The need for re-dispatching comes from the fact that distribution constraints are not adequately taken into account in the existing wholesale and balancing markets. To the extent that this can be solved, there will be less need for flexibility markets, but that is a discussion beyond the scope of this paper. A discussion of so-called nodal pricing for distribution grids can be found in the MIT Utility of the Future report (MIT Energy Initiative, 2016) and a discussion of how zonal pricing could be implemented at distribution level can be found in Hadush and Meeus (2018).

The paper is organised as follows. In Section 2, we introduce our six-question framework. In Section 3, we analyse the four pioneering projects using the six-question framework. The six questions are: (1) Is the flexibility market integrated in the existing sequence of EU electricity markets; (2) Is the flexibility market operator a third party; (3) Are there reservation payments; (4) Are the products standardised; (5) Is there TSO-DSO cooperation for the organisation of the flexibility market; (6) Is there DSO-DSO cooperation for the organisation of the flexibility market. Per question, we first answer for each project and then provide a discussion. Finally, a conclusion is provided.

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1 See Art. 32 ‘Incentives for the use of flexibility in distribution networks’ in the Directive for the internal market in electricity (recast) (European Commission, 2019).

2. Six controversies around flexibility market design based on the literature and stakeholder reports

In this section, we introduce six controversies around the design of flexibility markets. These six controversies are based on a survey of existing academic literature and stakeholder reports recently published on the topic of flexibility markets. Table 1 maps the used documentation upon the six controversies. In the following of this section, we briefly discuss each controversy one by one and illustrate that the identified controversy also came up in the debate on the design of other electricity markets.[2]

Table 1: Overview of the six design controversies and mapping of relevant literature

	Academic work	Stakeholder reports
1. Is the flexibility market integrated in the existing sequence of EU electricity markets?	(Gerard et al., 2018; Ramos et al., 2016; Vicente Pastor et al., 2018; Villar et al., 2018)	(ENTSO-E et al., 2019; USEF, 2018)
2. Is the flexibility market operator a third party?	(Burger et al., 2019a; Gerard et al., 2018; Ramos et al., 2016; Stanley et al., 2019)	(ENTSO-E et al., 2019; USEF, 2018)
3. Is there a reservation payment?	(Ramos et al., 2016)	(CEER, 2018; EDSO et al., 2017; ENTSO-E et al., 2019)
4. Are products standardised in the flexibility market?	(Villar et al., 2018)	(CEER, 2018; EDSO et al., 2017; ENTSO-E et al., 2019)
5. Is there TSO-DSO cooperation for the organisation of the flexibility market?	(Brunekreeft, 2017; Burger et al., 2019a; Gerard et al., 2018; Hadush and Meeus, 2018; Le Cadre et al., 2019; Ramos et al., 2016)	(CEER, 2018; EDSO et al., 2018; ENTSO-E et al., 2019; USEF, 2018)
6. Is there DSO-DSO cooperation for the organisation of the flexibility market?	(Hadush and Meeus, 2018; Stanley et al., 2019)	/

First, flexibility of resources connected to the distribution level has multiple use cases, i.e. flexibility for the grids of network operators, for system balancing or for portfolio balancing of Balance Responsible Parties (BRPs). Different market design options are possible. ENTSO-E et al., (2019), Gerard et al. (2018), Ramos et al. (2016), USEF (2018) and Villar et al. (2018) all discuss the option to create a separate flexibility platforms for congestion management with the network operators (the DSO and possibly the TSO) as single buyers or to have a so-called integrated market model, i.e. DSOs contracting flexibility for congestion management through the existing markets (day-ahead, intraday and/or balancing). Vicente Pastor et al. (2018) do a game-theoretical analysis of the different options. Their analysis suggest that the most effective co-ordination would be regulated cooperative dispatch between all network and system operators, and a separate competitive market for BRPs. This dilemma is not completely new. For example, the balancing energy market can be integrated with the transmission redispatch market, as is the case in GB and the Nordics. Similarly, in most systems in the US and in few systems in Europe (e.g. Poland), co-optimization is applied, i.e. balancing markets and wholesale electricity markets are cleared jointly (see for example Dallinger et al. (2018) for a discussion and ENTSO-E (2018) for an overview).

Second, there is a debate about who should be the market operator. Burger et al. (2019a), Stanley et al. (2019), Ramos et al. (2016) emphasize that to ensure transparency and prevent foreclosure the market operator must maintain complete independence from market activities. Gerard et al. (2018) and USEF (2018) note that the party being the market operator will be a function of whether the flexibility market is separated or integrated with other markets. Finally, ENTSO-E et al. (2019) stress that network

[2] For a more detailed description of these different existing electricity markets please consult Schittekatte et al. (2019).

operators should act as neutral market facilitators.[3] Looking at the existing electricity markets in the EU, it can be seen that the market operator role depends on the specific market. For example, wholesale markets are operated by (third-party) power exchanges while markets for system services, e.g. balancing markets and redispatch markets, are currently operated by the TSO. However, things are also moving in that regard. Namely, very recently, EPEX SPOT and National Grid joined forces to develop and operate a platform which will host a brand-new firm frequency response auction trial in Great Britain in 2019 (EPEX SPOT, 2018).

Third, there is the option to include a reservation payment. One of the possible models of flexibility markets envisioned by Ramos et al. (2016) includes long-term contracts used for assuring availability of flexibility reserves with an activation market near real-time. In that respect, CEER (2018) recognises that a lack of liquidity in flexibility markets may lead to a situation where long-term contracts may still be needed in some cases. ENTSO-E et al. (2019) describe that different situations in different Member States might require either more short or more long-term products or a combination of both. Finally, EDSO et al. (2018) note that long-term contracts are beneficial for the investment security of the flexibility providers. Again, the discussion about having reservation payments is not new. For example, balancing capacity markets are used to reserve resources for the balancing energy markets. In contrast, market players offering their resources in the wholesale market are not subject to a reservation payment.[4]

Fourth, there is a discussion about which type of products should be traded in flexibility markets, i.e. whether they should be standardized (and how) or whether flexibility providers should be allowed more freedom in characterizing their offers. Villar et al. (2018) classify flexibility products considering its main attributes such as scope, purpose, location or provider. ENTSO-E et al. (2019) recommend that product standardization is implemented at least at the Member State level to limit the costs for market participants in offering the products. EDSO et al. (2018) list up the many different product attributes that can be thought of. Besides standardizing products in a flexibility market, there is also a discussion on whether products should be standardized on an EU-level. In that regard, CEER (2018) believes that there is no 'one-size-fits-all' approach. Also in existing electricity markets, products differ from market to market. For example, tailor-made trades can be done in bilateral (over-the-counter) markets. Also, products in wholesale markets have less strict design parameters than for example products in balancing markets.

Fifth, TSO-DSO cooperation is very much debated when discussing flexibility markets. Most academic papers, i.e. Brunekreeft (2017), Burger et al. (2019a), Gerard et al. (2018), Ramos et al. (2016), and most stakeholder reports, i.e. CEER (2018), EDSO et al. (2018), ENTSO-E et al. (2019) and USEF (2018) all discuss whether the DSO and TSO should procure flexibility in the same market. If the DSO and TSO organize the flexibility market together, more questions arise regarding whether the DSO or the TSO should have priority over flexible resources connected to the distribution grid. Also, how real-time TSO-DSO coordination should be done when a flexible resource is activated in one of the networks is undetermined for now. In that respect, Hadush and Meeus (2018) describe how TSO-DSO coordination could take inspiration from the experiences with TSO-TSO coordination for the organization of wholesale and balancing markets. Finally, Le Cadre et al. (2019) do a game-theoretical analysis of TSO-DSO coordination. They observe that in terms of resource allocation, the centralized co-optimization of transmission and distribution network resources are the most efficient, followed very closely by a so-called decentralised coordination scheme in which the TSO and DSO simultaneously clear their local markets estimating the flows resulting from the dispatch of the DSO or TSO respectively. A third tested coordination scheme in which the DSOs act first, anticipating the behaviour of the other DSOs and the TSO, results in a lower efficiency. In most current electricity markets, both resources from the distribution and transmission-level can participate, i.e. the wholesale markets,

[3] We understand under a neutral market facilitator a party that guarantees equal market access for all market parties but not necessarily a party that takes up the role of market operator.

[4] Excluding capacity mechanism which can be seen as a reservation mechanism to ensure adequacy,

balancing markets and even capacity mechanisms. However, in principle, all these markets could be separately organized at transmission and distribution level. For example, Burger et al. (2019a) and Gerard et al. (2018) discuss the option to have DSOs doing local balancing.

Sixth, the last identified controversy is DSO-DSO cooperation.[5] Hadush and Meeus (2018) are one of the few authors explicitly mentioning DSO-DSO cooperation. They state that the trend towards local energy systems might make DSO-DSO cooperation as important as the DSO-TSO cooperation, especially when DSOs start to use and organize flexibility markets for local congestion management. Stanley et al. (2019) note that increasingly, the aggregators of distributed flexibility and DER resources act across whole states, provinces and, in the future, across borders. Therefore, flexibility providers would benefit from streamlined interfaces with different DSOs. In existing markets, the focus was so far on TSO-TSO cooperation. TSO-TSO cooperation can vary to a great degree depending on the market. For example, strong TSO-TSO cooperation is in place for the day-ahead wholesale market, i.e. market coupling, while the TSO-TSO cooperation is currently less developed in balancing markets.

3. Analysing four pioneering projects

This section contains two parts. First, the four pioneering projects are introduced. Second, we go over the question per identified design controversy. Per question, we explain how each project answers the question, followed by a discussion.

3.1 Introducing the four pioneering projects

First, Piclo (previously known as Open Utility) is an independent software company that has been active in the energy industry since 2013. In October 2016, Piclo launched its first energy application, Piclo Match, a peer-to-peer energy matching service (Johnston, 2017). In this paper, we focus on Piclo's second application, namely Piclo Flex, which was launched in June 2018. Currently, six DSOs in the UK are Piclo Flex members: UK Power Networks (UKPN), Scottish and Southern Electricity Networks, Electricity North West Limited, Northern Powergrid, SP Networks and Western Power Distribution. We mainly focus on how UKPN uses Piclo to procure flexibility as UKPN is the most active Piclo Flex member to date (Stanley et al., 2019). In March 2019, the first flexibility tenders to deliver flexibility needs for 2019/20 and 2020/21 were organised by UKPN on Piclo Flex.

Second, Enera is a joint project between the power exchange EPEX SPOT, one of the German TSOs TenneT DE and the German DSOs Avacon Netz and EWE NETZ. A scalable pilot is built up in a showcase region, in this case in the windy Northwest of Germany. The main goal is to enable flexible solutions to avoid uneconomic curtailment of excess wind energy. In Enera, network operators can buy flexibility in the intraday time frame to proactively alleviate congestion.[6] The first trade was cleared on the 4th of February 2019 at 15h25. Audi (with a Power-to-Gas unit) committed to increase its consumption by 2 MW at the request of EWE NETZ for delivery on the same day from 17h00 to 18h00.

Third, GOPACS stands for Grid Operators Platform for Congestion Solutions. GOPACS is owned and operated by the Dutch TSO and four DSOs (Stedin, Liander, Enexis Groep and Westland Infra). GOPACS is different from the other initiatives presented in this paper in the sense that it is not a market platform, i.e. no flexibility offers are cleared on GOPACS. Instead, it acts as an intermediary between the needs of network operators and markets. Currently, GOPACS is connected to a national intraday

[5] Please note that multiple configurations are possible; DSOs can be connected horizontally but also vertically.

[6] At the time of writing, in Germany, redispatch is regulated, i.e. audited cost or foregone revenues should be paid to the TSO-connected market parties which are activated for redispatch. As long as this is the case, the only way DSO-connected flexibility providers can compete to deliver flexibility to the TSO is by offering flexibility at a lower price than the costs of the TSO-connected redispatch resources.

platform Energy Trading Platform Amsterdam (ETPA), which is operational in the Netherlands.[7] Offers from flexibility providers active on ETPA can be procured by GOPACS if they add a locational tag. In the near future, GOPACS intends to be connected to more market platforms.

Fourth, NODES is a joint venture between the Norwegian utility Agder Energi and the European power exchange Nord Pool. NODES was established in early 2018. Currently, NODES is active in two pilots. One installation is in place in Norway with the DSO Agder Energi Nett. Another installation is in use by the German DSO Mitnetz Strom, which is situated in the TSO area of 50Hertz. These pilots are quite different in aim as the Norwegian DSO mostly suffers from growing loads which could require an upgrade of a transformer, while the German DSO needs flexibility to avoid curtailment of renewables (USEF, 2018). On the NODES platform, balance responsible market parties (BRPs) and network operators can procure local flexibility in the intraday timeframe. The offered flexibility, which is not needed locally, will be forwarded to other existing market platforms, i.e. the intraday and balancing market. Currently, the interfaces between NODES and the existing markets are not in place yet.

3.2 Analyzing the projects on the basis of six design controversies

3.2.1 Is the flexibility market integrated in the existing sequence of EU electricity markets?

In this subsection, we focus on the integration of flexibility markets with wholesale and/or balancing markets. The integration of DSO flexibility markets and TSO redispatch markets is discussed in Section 3.2.5. First, we answer the question for the different projects. After, a discussion follows.

The answer of the projects to the question

In what follows we explain that there are two projects which provide separate platforms, i.e. Piclo Flex and Enera, and two projects for which the flexibility market is integrated to a certain degree in the existing sequence of markets, i.e. GOPACS and NODES.

First, Piclo Flex is clearly a separate platform from the existing sequence of electricity markets. Tenders are organised on Piclo Flex with a lead-time of six months or more, and the contract duration is between a couple of months and 4 years (UKPN, 2018). A pre-qualified flexibility provider participating in the tender has to submit both an availability offer - the price in £/MW/h for availability and a utilisation offer - the price in £/MWh for utilisation and the maximum running time (Piclo, 2019). Contracted flexible resources on Piclo Flex do not have to adhere to dispatch instructions by the DSO for the full contracted period but only during a service window within the contracted period (e.g. winter week-day evenings), which is predetermined at the time of the tender.

Second, Enera is also a separate platform. Enera runs in the intraday timeframe. Flexibility providers submit offers and network operators submit flexibility demand orders that are continuously matched on the platform. Access to the Enera trading platform is standardized, i.e. market parties can use the same API which they use to trade in the intraday (energy) market when using EPEX SPOT's services. Market parties have the option to submit offers with the same underlying asset for the different markets. The offers can differ in price. However, if all offers on the different markets were cleared, the activations would be incompatible. The responsibility to avoid double activation lies with the flexibility providers.

Third, GOPACS is integrated into the existing sequence of markets. The integration is achieved by sourcing flexibility from existing platforms. Currently, GOPACS is only connected to ETPA but connections with other markets are envisioned. On ETPA, locational flexibility offers for network operators are not placed on a separate platform but instead are seen as a subset of the (wholesale) intraday order book. Network operators and market parties (BRPs) can procure the same flexibility.

[7] Besides intraday, ETPA offers also day ahead, week and weekend contracts.

Flexibility providers have the option to offer the same flexibility at two different prices by placing two orders, e.g. one portfolio offer for the intraday wholesale and a second offer with locational information. The flexibility provider is responsible for avoiding double activations. How GOPACS will connect the cross-zonal intraday markets and balancing markets still needs to be seen.

Fourth, NODES is integrated into the existing sequence of markets. The integration is achieved in two ways. First, NODES is an intraday platform like ETPA and similar to GOPACS, network operators source their flexibility offers on the same platform as market parties (BRPs). Again, flexibility providers can construct different offers with the same underlying assets for different prices and the flexibility provider is responsible for avoiding double activations. Second, the flexibility provided on the NODES platform, which is not needed locally, is envisioned to be forwarded to other market platforms, i.e. the cross-zonal intraday and balancing market (NODES (2018)).

Discussion

One argument in favour of separate platforms and three arguments in favour of integrated platforms are identified.

As also described in USEF (2018), the main argument to use separate platforms is that the differences between the products (locational or not) are highlighted and transparency on price levels is created.

A first argument in favour of integrated markets is liquidity pooling. However, products differ on the integrated platform (locational or not) and flexibility providers have the option to place separate offers for the same underlying assets. Note that this argument would be stronger if auctions were used instead of continuous trading (as in Enera, ETPA and NODES). With auctions, the needs of the market parties and network operators would be combined at one point in time; as such, the flexibility could be allocated more efficiently.[8]

A second argument in favour of integrated markets is the simplicity of making one platform available to which smaller market parties can connect and submit just one offer that can serve for congestion management, balancing or for a BRP to balance its portfolio. This reduces complexity and the access costs to different platforms.

A third argument in favour of integrated markets is that by allowing other market parties (BRPs) to procure locational flexibility in the same market as network operators, that market can de facto function as a secondary market for flexibility providers.

3.2.2 Is the flexibility market operator a third party?

First, we answer the question for the different projects. After, a discussion follows.

The answer of the projects to the question

In all four cases, a third party operates the platform.

First, Piclo Flex is developed and operated by a new entrant in the energy business.

Second, in the case of Enera, EPEX SPOT, built up the platform, which is one of the two largest power exchanges in Europe.

Third, similarly, for NODES, Nord Pool, the other large European power exchange is backing up the development. Besides Nord Pool, the other party owning NODES is Agder Energi. Agder Energi holds both distribution network assets and generation assets. In the white paper of NODES (2018), it is stated

[8] However, in case of low liquidity, there are also arguments in favor of continuous trade.

that if NODES is in full operation, it will need to be an independent party. As such, Agder Energi will not be a major owner of the marketplace.

Fourth, in the case of GOPACS, currently, the platform provider is ETPA which is a new independent power exchange. GOPACS is an intermediary between the network operators and the market platform.

Discussion

It is important to emphasize that this question is not black and white, i.e. several market operation tasks (e.g. clearing and settlement) could be allocated to third parties while other tasks could be the responsibility of the DSO (e.g. validating offers and product design). More general, three arguments in favour of having a third party as market operator are identified and one argument against.

First, in the case of DSOs, the know-how might not always be present in-house to build up market platforms from scratch. Stanley et al. (2019) points out an engagement with a specialised third party can allow for a faster development of the procurement mechanisms of new services.

Second, an argument often brought up by power exchanges is that by letting the market operation function over to a third party, neutrality between buyers and sellers is ensured. Also, in the case both DSOs and the TSO use the same platform to procure flexibility or the flexibility market is integrated in, for example, a local wholesale market, the neutrality among buyers is assured by having a third party as market operator. Burger et al. (2019a) emphasizes that neutrality is even more important if the network operator would own distributed energy resources itself (e.g. a battery).

Third, if network operators (DSO or TSO) operate the market platform for flexibility procurement, the platform will be monopolistic by nature. However, if a third party operates the platform, this is not necessarily the case. The question of whether market operation is a monopolistic activity or whether it can be a competitive activity is discussed in depth in Meeus (2011) for wholesale markets. In that paper, it is argued that due to network effects it is hard to have well-functioning competition between market platforms but that allowing competition has several advantages, for example, stronger incentives for innovation.

An argument against having a third party as a market operator is the cost of interface management between the grid operator and the market operator. There is always a cost to manage interfaces between different parties when formerly integrated activities are unbundled. Another (more extreme) example of the trade-off between removing conflicts of interest and the costs of interface management is the debate about the unbundling of TSOs or DSOs in network asset owners (TNO or DNO) and a system operator (ISO) as documented by Pollitt (2012) for TSOs and more recently debated in Burger et al. (2019b) for DSOs.

3.2.3 Is there a reservation payment?

First, we answer the question for the different projects. After, a discussion follows.

The answer of the projects to the question

Looking at the four projects, currently, there are only reservation payments done in Piclo Flex. An important feature of the flexibility tenders organised on Piclo Flex is that revenue stacking, i.e. contracting with multiple other services, is allowed.[9]

Enera, GOPACS and especially NODES all mention that in the future they intend to set up or integrate longer-term availability markets.

[9] One exception applies, flexibility contracted on Piclo by the DSO to defer reinforcement cannot offer additional services which require an increase in active load, unless outside of contracted service windows.

Discussion

Two arguments in favour of reservation and two arguments against reservation payments are identified.

First, long-term contracts are a way to manage the risk between the grid operator and the market parties, i.e. a guarantee that there will be flexibility at all times. An issue with services for very specific locations is that there are not necessarily many parties present that can offer the service in need. One of the possible remedies for such an issue is long-term contracts with a sufficiently long lead-time and contract duration. As such, flexibility providers are given enough time to make the necessary investments and enough certainty about future revenue streams. This is also what UKPN (2018) mentions in its Flexibility Roadmap. Namely, for reinforcement deferral (due to an increase of load), the lead-time between the tender and the start of the contract is 6 months or 18 months. Reinforcement deferral is the main use case of UKPN at this moment.[10] In the future, the lead times might be reduced significantly to, for example, one week. Currently, for example for Enera, the use case is the avoidance of curtailment, which can explain why no reservation is in place yet.

Second, long-term contracting is a way to mitigate gaming. Two types of gaming can be distinguished: gaming within a market and gaming between markets. First, as also discussed in Ramos et al. (2016), there might be moments that very few market players are able to offer flexibility at a specific location and as such, these players can make use of market power to elevate prices above competitive levels. Second, by having a wholesale electricity market with a large geographical coverage and subsequently redispatch markets at a more local level, market players can consciously create congestions by bidding in a particular way in the wholesale market and then be paid in the redispatch market to solve the problem they created themselves. This is possible under the condition that market players have a good idea of the bottlenecks in the grid. This strategy was coined as the incrementals-decrementals (inc-dec) game by Stoft (1999). Holmberg and Lazarczyk (2015) and Hirth and Schlecht (2019) show that inc-dec gaming is an arbitrage strategy that can even be successful in the absence of market power. Besides long-term contracting, there are other possible remedies to limit gaming in flexibility markets. As also discussed in Neuhoff et al. (2018), examples are: extensive (automatic) market monitoring and enforcement of anti-trust law, price caps and introducing temporary administrative prices in locations where there are few players or where structural congestion is present.[11]

A first argument against reservation payments is that short-term efficiency is sacrificed to a certain extent. However, this is only true if the utilisation payments are determined at the time of the (reservation) tender. The moment that there are enough market parties competing to offer flexibility near real-time, the requirement to determine the utilisation payment at the time of the (reservation) tender could be discarded. This is similar as is done in balancing markets in the EU. Namely, balancing capacity is procured solely based on the balancing capacity offers submitted by the Balancing Service Providers (BSPs). In real-time, there is competition for activation between contracted and non-contracted balancing resources (EC (2017), Art 16(5-6)).

A second argument against reservation payments, especially with long contract durations, is that it can be harder for certain resources due to forecasting difficulties (e.g. demand response) to guarantee availability for a long time horizon. Thus, reservation can act as an entry barrier for these flexible resources.

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[10] Other use cases are maintenance and dealing with unplanned interruptions (pre- and post-fault). Depending on the use case, the exact tender design can differ.

[11] Another way to avoid gaming is to completely regulate redispatch and remunerate instructed redispatch actions based on the audited costs or forgone revenue of the called-up resource. However, it is believed that market-based redispatch can bring gains by driving redispatch costs down due to competition and can provide better price signal for where to locate future flexibility generation or demand. Another issue with a regulated approach for redispatch is that it is very hard to estimate the costs to redispatch the new generation of flexible resources such as demand response and storage. As such, these resources would be hard to deploy for such purpose, even though they could be of great value for the system. Overall, there is a trade-off between benefitting from competition and possibilities for gaming.

3.2.4 Are products standardised in the flexibility market?

First, we answer the question for the different projects. After, a discussion follows.

The answer of the projects to the question

For three of the projects it can be said that products are standardized, i.e. Piclo Flex, Enera and GOPACS. However, the designs of the standardized products differ substantially between the projects. Products in NODES are not standardized.

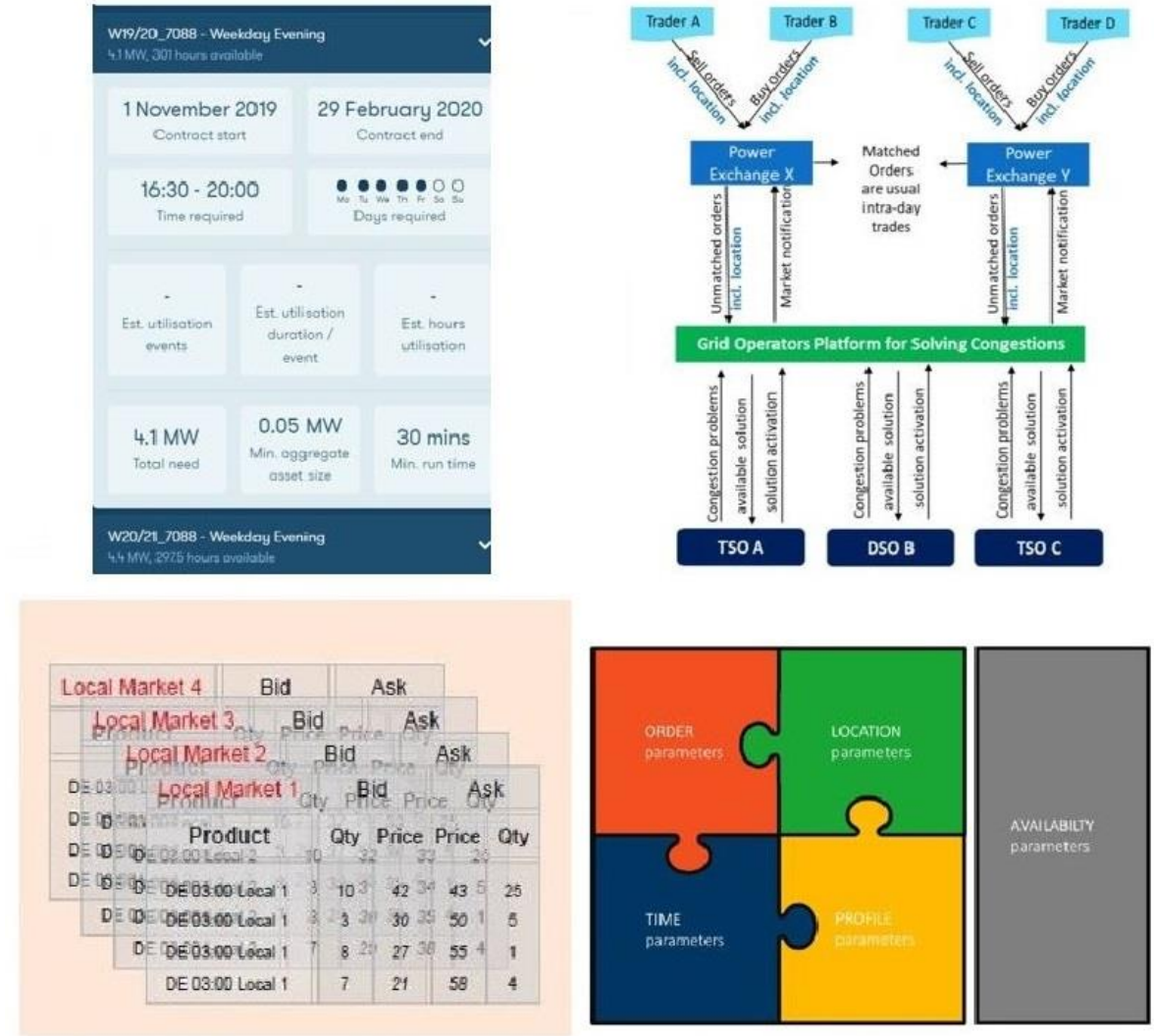
First, in Piclo Flex standardized products are in place. The short-term activation product is determined per competition area at the time of the tender. At the time of writing, UKPN has 28 competition areas defined in Piclo Flex. Besides location and voltage level, the key operational parameters are the service window (and the contract duration during which this service window holds) and the minimum and maximum running time (see also the upper left image in Figure 1). All other technical parameters are validated during the prequalification process.

Second, in Enera, standard product definitions are determined by EPEX SPOT in cooperation with the network operators procuring the flexibility. The products look similar as in the intraday, e.g. blocks of energy up or down for a certain duration (e.g. 1 hour or shorter) for a certain location as shown in the lower left image in Figure 1. In terms of locational tagging, each order belongs to a certain node predefined by Enera. In the current pilot thirteen nodes at the 110kV voltage level are defined.

Third, GOPACS, as is currently in place, procures standardized products from ETPA to which a locational tag is added. The locational tag is called an EAN-code. Unique to GOPACS is that it always procures a combination of two orders (a buy and a sell order). This product is called an Intraday Congestion Spread (IDCONS) (GOPACS, 2019). The buy and sell orders have the same format as intraday wholesale orders (simple bids of 15 minutes or 1 hour), and orders agree in starting time, volume and duration but are located in a different area. The upper right image in Figure 1 illustrates the IDCONS product. For example, imagine a congestion in one part of the network due to high load. One energy sell order will be procured by GOPACS in that part of the grid. At the same time, in a non-congested area, an energy buy order will be activated. As such, an energy imbalance is avoided. The price of the energy sell order will be higher than the price of the energy buy order. The network operator who requests the flexibility pays the spread between the orders.

Fourth, in NODES no standard product definitions are set. Instead, flexibility providers have the choice to specify their offers using a wide range of parameters. Examples are technical and financial parameters, but for example also the generation source can be specified. The lower right image in Figure 1 shows the different groups of parameters. As such, a catalogue is build up with flexibility offers. Flexibility buyers can filter offers from the catalogue and then select the cheapest offer that fulfils their needs. NODES also allows network operators to create a template with the parameters they would like to see specified. In terms of location, flexibility offers can indicate in which grid locations (GL) they are connected. DSOs and TSOs determine the delineation of GLs, which are smaller for DSOs than TSOs and always smaller than bidding zone areas.

Figure 1: Illustration of the different short-term market products in Piclo Flex (service window) –upper left, Enera (locational orders) –lower left, GOPACS (IDCONS product) – upper right, and NODES (different types of parameters) –lower right



Discussion

We identified one argument in favour of standardized products and two against.

The main argument in favour of standardised products is to allow for a sufficient level of liquidity, i.e. standardized products allow for building up a merit order to organize competition. As a result, with standardized products price transparency is promoted. It is more difficult to compare the value of offers in case of unstandardized products. The number of different flexibility offers that can be made increases exponentially as a function of the possible product parameters.

The first argument against standardised products is that with standardised products it is hard to meet very specific flexibility needs of network operators.

A second argument against standardised products is that a catalogue approach has the advantage for flexibility providers that specific characteristics of their flexibility (e.g. reaction time or emissions) can be better valued. Flexibility providers can customize their offers and ask for premiums when an asset has valuable attributes which would otherwise not be valued if they were not part of the product definition.

3.2.5 Is there TSO-DSO cooperation for the organisation of the flexibility market?

First, we answer the question for the different projects. After, a discussion follows.

The answer of the projects to the question

The projects differ in how TSO-DSO cooperation is dealt with. GOPACS is built-up and used by one TSO and four DSOs. Enera and NODES allow for TSOs to procure flexibility on the same platform as DSOs but TSOs are not active yet. Piclo Flex is solely used by DSOs.

First, GOPACS is very relevant in this regard. GOPACS is one of the first implemented TSO-DSO coordination platforms. In its current version, GOPACS assures that no conflicting activations occur. In the future, the idea is also to identify synergies between the needs of different network operators.

Second, solely one DSO is procuring flexibility currently on Enera, but the TSO is expected to also become an active buyer in May 2019. In the first step of the Enera project, so-called Enera 1.0, the DSOs and the TSO are expected to communicate bilaterally when activating an offer to avoid conflicts. In the future, the idea is to have a 'vertical coupling' in place, i.e. offers will be filtered on the market platform in a way that no conflicting activation can occur, similar to how cross-zonal offers/bids are not accessible if cross-zonal links are congested in (horizontal) market coupling.

Third, currently, no TSO is active in a NODES installation. Soon the TSO will be active in the Norwegian pilot. In the future, TSO-DSO cooperation is intended to be dealt with by filtering out the offers available to one network operator if they would cause problems for other network operators. Also, the way how grid locations (GLs) are defined, which are nothing more than clusters of physical points, can help making actions of one network operator more transparent for other network operators in order to avoid conflicting activations.

Fourth, currently Piclo Flex is solely used by DSOs and the cooperation with the TSO is limited at the moment. When a DSO activates a resource for congestion management, the DSO has to notify the TSO.

Discussion

We identify three arguments in favour of TSOs and DSOs using the same platform to procure flexibility and one argument against.

First, fewer platforms need to be built-up and it limits the number of market platforms a flexibility provider needs to take into consideration when marketing its flexibility.

Second, liquidity increases in case TSOs and DSOs procure flexibility on the same platform, i.e. one asset connected at the distribution level can be procured by either the TSO or the DSO to solve congestions.

Third, by using the same or a similar platform, real-time coordination between the TSO and DSOs could be facilitated. Currently, real-time TSO-DSO coordination is focused on avoiding conflicting activations by the different network operators. In the future, finding synergetic activations is expected to be developed, i.e. the activation of a flexibility resource able to solve issues in both networks.

An argument against directly introducing a platform where both DSOs and TSOs procure flexibility is speed. It costs time to set up the collaboration with a TSO and by starting with a platform only for one or multiple DSOs initial experience can be gained.

3.2.6 Is there DSO-DSO cooperation for the organisation of the flexibility market?

First, we answer the question for the different projects. After, a discussion follows.

The answer of the projects to the question

All platforms are intending to engage with more DSOs in the future in order to position their (customisable) flexibility market platform as the standard solution in Europe.

First, currently six DSOs use the same platform provided by Piclo Flex. The dashboard of the platform shows all the flexibility needs of these different DSOs on one map.

Second, on Enera, currently one DSO is active, EWE NETZ. Soon, a second DSO, Avacon Netz, will become active. The case of Enera is different from Piclo Flex in the sense that DSOs are vertically connected. Namely, EWE NETZ is connected to Avacon Netz, which is in its turn connected to the TSO TenneT DE.

Third, in the case of GOPACS, four DSOs besides the TSO are using the same TSO-DSO coordination platform.

Fourth, currently, in each NODES installation solely one DSO is active. More DSOs are expected to join the platforms soon.

Discussion

Three arguments in favour of DSOs using the same platform to procure flexibility are identified and one argument against.

The first argument in favour is that when DSOs cooperate and use the same platform, the learning costs for flexibility providers with assets in different DSO areas to use the platform can be limited. This is also described by Stanley et al. (2019) who discuss the Piclo Flex platform in more depth.

Second, when DSOs use the same platform, the difficulty for the TSO to create a different TSO-DSO interface with all DSOs and other relevant companies could be reduced.[12]

Third, from an operational point of view, activations near the boundaries of two DSOs could affect each other networks if they are horizontally (or exceptionally, vertically) connected, similarly as is the case between two TSOs at the transmission level. For example, it could be that there is a congestion issue in the area of one DSO, but that cheaper flexibility that could solve that problem is available in the area of another DSO. In such a setting, coordination and cost sharing agreements between DSOs needs to be developed which are easier to develop if the same or similar flexibility platforms are used.

An argument against DSOs using the same platform to procure flexibility is that standardising the DSOs platforms to a certain extent, i.e. winner-takes-it-all, could limit benefits from innovation and competition between platform providers.

4. Conclusion

Table 2 summarizes the answers of the four projects to our six-question framework. We can observe two trends and find four differences.

A first important trend is that all the considered platforms are operated by a third party. This is relatively new in the sphere of ancillary service procurement (e.g. balancing and redispatch) in the EU where the markets are currently operated by the TSOs.

[12] An example of another company is a Balancing and Settlement Code (BSC) company which can take over some tasks of the TSO related to the imbalance settlement (e.g. as is the case in GB with Elexon).

A second trend is that all projects engage or tend to engage with multiple DSOs. By doing so, the different platforms providers try to become the first-choice flexibility platform provider and become the lead player that ca replicate its solution across the EU and further.

A first difference is the extent to which flexibility markets are integrated with other markets. Piclo Flex and Enera are clearly separated platforms, i.e. flexibility providers submit their locational offers and only network operators can procure this flexibility. GOPACS and NODES are integrated platforms on which both market parties (BRPs) and network operators can procure the same flexibility. Both GOPACS and NODES intend to connect to more existing electricity markets (e.g. cross-zonal intraday and balancing).

A second difference is that the projects differ in the use of reservation payments. Piclo Flex is the only one reserving flexible resources (six months or more ahead). The other platforms think about integrating availability markets but currently focus on competition in the intraday timeframe. The use of reservation payments is strongly linked with the use-case, i.e. reinforcement deferral for Piclo Flex. Also, short-term flexibility markets can provide such price signal but might need some time before the price signal is stable enough.

A third difference is related to the use of standardised products. In Piclo Flex, Enera and GOPACS standardised products are used. In contrast, NODES uses a novel approach, i.e. flexibility providers can customise their offer by specifying a multitude of parameters.

Finally, a fourth difference that can be found is the way TSO-DSO cooperation is done in the projects. Piclo Flex is a DSOs-only solution. In the other projects, DSOs and TSOs are organising the flexibility markets jointly. However, the question arises whether real-time TSO-DSO coordination should be dealt with outside of the flexibility market platform, e.g. procuring flexibility through an intermediary as with GOPACS, or whether TSO-DSO coordination should be dealt with by the flexibility market platform by for example filtering offers or 'vertical coupling' as it is envisioned by NODES and Enera.

Regarding future work, it will be interesting to revisit this analysis in two to three years to see whether the answers to the six design controversies consolidated or not. Also, the first market data could be available by that time and quantitative analysis could extend this work.

Table 2: Overview the answers of the four projects for the six design controversies

	YES	NO
1. Is the flexibility market integrated in the existing sequence of EU electricity markets?	GOPACS and NODES	Piclo Flex and Enera
2. Is the flexibility market operator a third party?	All projects. GOPACS is not a market platform operator but an intermediary. Currently, the market platform is ETPA.	/
3. Is there a reservation payment?	Piclo Flex	Enera, GOPACS and NODES (all projects envision to integrate reservations)
4. Are products standardised in the flexibility market?	Piclo Flex, Enera and GOPACS (IDCONS product)	NODES
5. Is there TSO-DSO cooperation for the organisation of the flexibility market?	GOPACS (TSO and DSOs use the same intermediary). Enera and NODES (soon also the TSOs will be active).	Piclo Flex is solely a DSO platform
6. Is there DSO-DSO cooperation for the organisation of the flexibility market?	Piclo Flex (6 DSOs), GOPACS (4 DSOs), Enera and NODES (one DSO active per installation, soon more will join)	/

Bibliography

Brunekreeft, G., 2017. Regulatory challenges of large-scale integration of renewables – governance of flexibility markets 1–14.

Burger, S.P., Jenkins, J.D., Batlle, C., Pérez-Arriaga, I.J., 2019a. Restructuring Revisited Part 2: Coordination in Electricity Distribution Systems. Energy J. 40, 55–76. doi:10.5547/01956574.40.3.sbur

Burger, S.P., Jenkins, J.D., Batlle, C., Pérez-Arriaga, I.J., 2019b. Restructuring Revisited Part 1: Competition in Electricity Distribution Systems. Energy J. 40, 31–54. doi:10.5547/01956574.40.3.sbur

CEER, 2018. Flexibility Use at Distribution Level, C18-DS-42-04.

Dallinger, B., Auer, H., Lettner, G., 2018. Impact of harmonised common balancing capacity procurement in selected Central European electricity balancing markets. Appl. Energy 222, 351–368. doi:10.1016/j.apenergy.2018.03.120

EC, 2017. COMMISSION REGULATION (EU) 2017/2195 of 23 November 2017 establishing a guideline on electricity balancing, Official Journal of the European Union.

EDSO, CEDEC, Eurelectric, GEODE, 2018. Flexibility in the energy transition. A toolbox for electricity DSOs.

EDSO, CEDEC, Eurelectric, GEODE, 2017. CEER Guidelines of Good Practice for Flexibility Use at Distribution Level: A joint DSO response paper 1–6. doi:C16-DS-29-03

ENTSO-E, 2018. Survey on ancillary services procurement, balancing market design 2017.

ENTSO-E, CEDEC, EDSO, Eurelectric, GEODE, 2019. TSO-DSO report: An Integrated Approach to Active System Management. doi:10.4219/gct-2005-161

EPEX SPOT, 2018. EPEX SPOT and National Grid to launch a frequency response trial, Press Release of 28 November 2018.

European Commission, 2019. DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on common rules for the internal market for electricity and amending Directive 2012/27/EU (recast), Brussels, 8 May 2019.

Gerard, H., Rivero Puente, E.I., Six, D., 2018. Coordination between transmission and distribution system operators in the electricity sector: A conceptual framework. Util. Policy 50, 40–48. doi:10.1016/j.jup.2017.09.011

GOPACS, 2019. IDCONS Productspecificaties, Version 1.0-Initial version.

Hadush, S.Y., Meeus, L., 2018. DSO-TSO cooperation issues and solutions for distribution grid congestion management. Energy Policy 120, 610–621. doi:10.1016/j.enpol.2018.05.065

Hirth, L., Schlecht, I., 2019. Redispatch Markets in Zonal Electricity Markets: Inc-Dec Gaming as a Consequence of Inconsistent Power Market Design (not Market Power). ZBW – Leibniz Inf. Cent. Econ. Kiel, Hambg. doi:10.2139/ssrn.3286798

Holmberg, P., Lazarczyk, E., 2015. Comparison of congestion management techniques: Nodal, zonal and discriminatory pricing. Energy J. 36, 145–166. doi:10.5547/01956574.36.2.7

Johnston, J., 2017. Peer-to-Peer Energy Matching: Transparency, Choice, and Locational Grid Pricing, in: Sioshansi, F.P. (Ed.), Innovation and Disruption at the Grid's Edge. Academic Press, pp. 319–330.

Le Cadre, H., Mezghani, I., Papavasiliou, A., 2019. A game-theoretic analysis of transmission-distribution system operator coordination. Eur. J. Oper. Res. 274, 317–339.

doi:10.1016/j.ejor.2018.09.043

Meeus, L., 2011. Why (and how) to regulate power exchanges in the EU market integration context? Energy Policy 39, 1470–1475. doi:10.1016/j.enpol.2010.12.019

MIT Energy Initiative, 2016. Utility of the future. An MIT Energy Initiative response to an industry in transition.

Neuhoff, K., Richstein, J., Piantieri, C., 2018. TSO-DSO-PX Cooperation II., Report on key elements of debate from a workshop on the Future Power Market Platform, DIW, Berlin.

NODES, 2018. A fully integrated market place for flexibility, White paper.

Piclo, 2019. Piclo Blog [WWW Document]. URL https://blog.piclo.energy/ (accessed 4.1.19).

Pollitt, M.G., 2012. Lessons from the history of independent system operators in the energy sector. Energy Policy 47, 32–48. doi:10.1016/j.enpol.2012.04.007

Ramos, A., De Jonghe, C., Gómez, V., Belmans, R., 2016. Realizing the smart grid's potential: Defining local markets for flexibility. Util. Policy 40, 26–35. doi:10.1016/j.jup.2016.03.006

Schittekatte, T., Reif, V., Meeus, L., 2019. The EU Electricity Network Codes (2019ed.). FSR Tech. Rep. 2. doi:10.2870/188992

Stanley, R., Johnston, J., Sioshansi, F.P., 2019. Platforms to support nonwire alternatives and DSO flexibility trading, in: Sioshansi, F.P. (Ed.), Consumer, Prosumer, Prosumager: How Service Innovations Will Disrupt the Utility Business Model. Academic Press, pp. 111–126.

Stoft, S., 1999. Using Game Theory to Study Market Power in Simple Networks. IEEE Tutor. Game Theory Electr. Power Mark. 33–40.

UKPN, 2018. Flexibility Roadmap, FutureSmart - a smart grid for all: Our transition to Distribution System Operator.

USEF, 2018. Flexibility Platforms, White Paper. Main authors: Hans de Heer en Willem van den Reek.

Vicente Pastor, A., Nieto Martin, J., Bunn, D.W., Laur, A., 2018. Evaluation of Flexibility Markets for Retailer-DSO-TSO Coordination. IEEE Trans. Power Syst. PP, 1. doi:10.1109/TPWRS.2018.2880123

Villar, J., Bessa, R., Matos, M., 2018. Flexibility products and markets: Literature review. Electr. Power Syst. Res. 154, 329–340. doi:10.1016/j.epsr.2017.09.005

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