INTERACTION BETWEEN LOCAL AND OPEN ENERGY MARKETS – GUIDELINES FOR LOCAL MARKET DESIGN

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Abstract

Local energy market provides a mechanism for consumers and prosumers to share or trade energy and flexibility within the community and to offer aggregated energy or flexibility to the external markets or to network operators. If a local market would be created within an off-grid community, the community members could design the market relatively freely. However, if a grid-connected community wants to gain the full benefits of the local market and all its potential revenue streams, the trading mechanisms and information exchange procedures must be designed to be compatible with the external markets. This paper analyses how the arrangements in the retail, wholesale and ancillary service markets affect the local markets and their design.

1 Introduction

Local energy market is a marketplace that 1) enables energy and flexibility (demand response or flexible generation) trading or sharing within local communities and 2) provides a tool for offering aggregated energy or flexibility from the local market to external markets (i.e. retail, wholesale, ancillary services) or to network operators. The interest towards local energy markets and their potential stems from the increasingly decentralized generation infrastructure, development in communication and control technologies, and changes in the regulatory framework aiming at consumer empowerment in the energy sector. Local market facilitates the utilization of locally produced energy within the local community and can bring both economic (i.e. savings in energy costs, revenue for surplus energy and flexibility service provision) and socio-economic (e.g. locally produced renewable energy, self-sufficiency) benefits for the members of the local community.

Local markets can provide flexibility services for various stakeholders. For example, distribution system operators (DSOs) can utilize aggregated demand response (DR) from the local market to cut peaks in order to reduce losses and delay network reinforcements [1]. Local market can also provide services for transmission system operators (TSOs) to maintain the balance between demand and increasingly intermittent supply [1]. Furthermore, retailers can utilize the flexibility in wholesale market portfolio optimization [1]. Further benefits of local markets have been reviewed in [2].

The local market may be facilitated by an energy community service provider (ECSP) which is a role that may be adopted by a retailer, an aggregator or another type of service provider. The ECSP may manage the supply, grid service and balancing service contracts, and represent the community as a whole on the centralized markets [3]. It can handle the bidding and balance management for the community [3].

If a local market would be created within an off-grid community, it could not provide services for the external stakeholders and the community members could design the market and necessary trading or sharing mechanisms relatively freely. However, if a grid-connected community wants to gain the full benefits of the local market and all its potential revenue streams, the trading mechanisms and information exchange procedures must be compatible with the external markets. This paper analyses how the arrangements in the retail, wholesale and ancillary service markets affect the local markets and their design. Issues to consider include, for example, market sequences, clearing schedules and eligibility of resources in wholesale and ancillary service markets, and balance settlement arrangements. In addition, the information exchange requirements from local markets are analysed. Finally, potential changes arising from the new European energy

legislation (e.g. Electricity Directive 2019/944 [4]) and implications for local markets are discussed.

2 Open market interaction

2.1 Retail market

A retailer may act as an ECSP, i.e. represent its customers (prosumers and consumers) in other markets and manage peer to peer trading. However, also other stakeholders may adopt the ECSP role. For the retailer, a third party ECSP utilising flexibility of the community (e.g. in the ancillary service market) increases the risk of imbalances. Because the local market concept does not limit the ECSP role to retailers, alternative ways to handle the balance responsibility have been proposed in [3]. Another risk is related to losing market position as the ESCP may also acquire energy for the community. However, this does not differ significantly from the competition with other retailers. If a retailer adopts the ECSP role, in addition to providing services to the community, it can utilize the flexibility in the wholesale portfolio optimization and share the potential savings with the community through lower electricity prices [1].

2.2 Wholesale market

It is unlikely that the consumption within the local market will be covered by local generation at all times. Thus, the ECSP will need to acquire electricity from the wholesale market. Trading in power exchanges is typically divided to two mechanisms: day ahead (DA) market and intraday (ID) market. In the day ahead market, bids are submitted until the gate closure. The intraday markets may apply continuous trading or auctions. Table 1 summarises trading arrangements in the Nordic power exchange Nord Pool and in the Iberian market operated by OMIE.

Table 1 Trading in Nordic and Iberian power exchanges [5-7]

	Nord Pool	OMIE
Day ahead	Continuous submission of orders until gate closure (12:00 CET) 14 countries, 21 bidding zones	Continuous submission of orders until gate closure (12:00 CET) 2 countries
Intraday	Continuous trading until 1 hour or 30 minutes before delivery, plans for intraday auctions	Six intraday trading sessions and continuous trading until one hour before delivery
Trade lot	0.1 MW	0.1 MW

Location of the resource/prosumer is not only relevant when providing services for the DSO. In some countries, there are several wholesale market bidding areas. For example, in the Nordic power exchange Nord Pool, Norway is divided into five bidding areas, Sweden into four and Denmark into two. Finland, Estonia, Latvia and Lithuania each represent one bidding area. For a retailer, purchasing of electricity from the wholesale market is a core operation. However, for newcomer ECSPs, the location of the customers and served communities is a more relevant issue (in order to reach the minimum threshold), especially if a country is divided to several bidding areas. Furthermore, trading fees in the power exchanges may be a challenge for small ECSPs, especially if they are fixed (instead of based on the amount of traded energy).

2.3 Ancillary service market

Local markets provide a way to offer aggregated flexibility to TSOs and DSOs. At the moment, the eligibility of aggregated resources and DR in the TSO level ancillary service markets varies vastly even within Europe (see [8-9]). The eligibility to frequency containment reserve (FCR-N for normal operation, FCR-D for disturbances), automatic and manual frequency restoration reserve (aFRR, mFRR) markets in case countries Finland and Portugal are presented in Table 2.

Table 2 DR access to ancillary service markets [8]

	Finland	Portugal
FCR	Min. bid size in FCR-N 100 kW, symmetric product. Small aggregated loads, storage and DR active in FCR-N. Min. bid size for FCR-D 1 MW. Consumption and independent aggregators very active.	No market, mandatory service for generators.
aFRR	Min. bid size 5 MW, can be asymmetrical. Open to all technologies, including DR, but only generation provides service at the moment.	Provided on a market basis, by mostly thermal and hydro units. Procured as a single product that needs to include both upwards and downwards capacity which is problematic for DR.
mFRR	Min. bid size 5 MW. All technologies eligible, DR represents about one third of bids.	Pilot project for DR participation. Only individual consumers who can offer > 1MW eligible.

Thus, all revenue streams envisioned for the local markets and energy communities are at the moment not available in all countries. In addition to the eligibility of DR as a resource, also the bid size requirements and requirements for symmetrical products may hinder the opportunities of local markets to provide services.

3 Information exchange

Utilising the local resource – regardless of whether it is done for the benefit of the community or e.g. to provide flexibility for the TSO – requires detailed information exchange both within the community and between other stakeholders. Fig. 1 shows from the perspective of an ECSP acquiring electricity for the local market members and selling their flexibility to the TSO (Fingrid), an example of how the schedules in the Finnish market affect local resources.

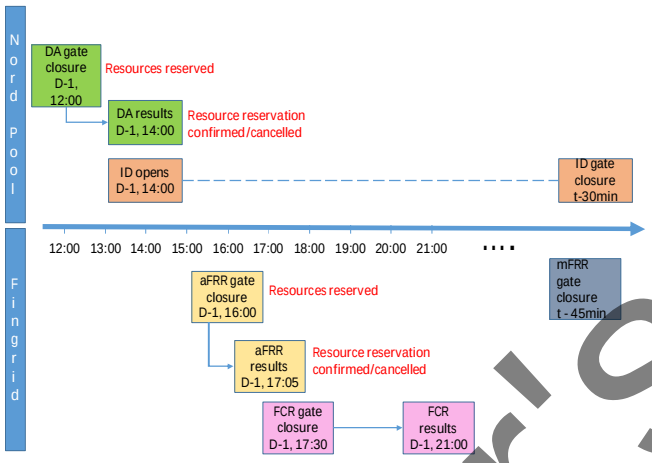

Fig. 1 Example of how schedules in the external markets affect local market [10]

The schedules in the wholesale and ancillary service markets set requirements also for the availability of the different forecasts (e.g. consumption forecast, flexibility forecast) as the stakeholder representing the local market, will need the information about the flexibility and its price early enough to be able to take them into account in the bids. The local market platform needs to allow reserving the resources for certain use and releasing the resources to other use if bids to open markets are not accepted.

Furthermore, even if a DSO would not utilize the services offered by the local market, it needs information about the trading. Typically, the DSO does not need information or interaction related to the wholesale and retail energy market trade. On contrary, at local level, both, the flexibility and the energy trade must be based on DSO´s interactions and technical validation. This requires a detailed, rigorous and qualified interface that can support and leverage a decentralized and transactive approach of the upcoming energy markets and electric system. Information to be exchanged between the DSO and market players is presented in Fig. 2.

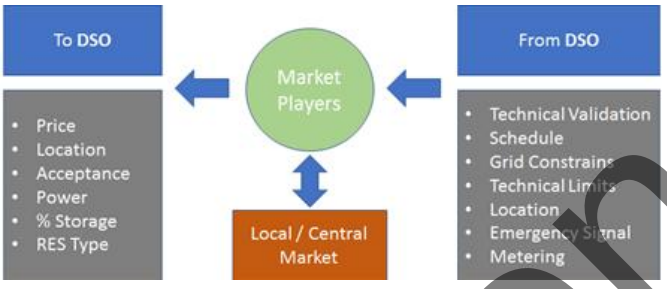

Fig. 2 Information exchange between DSO and market players [10]

As mentioned in section 2.1, retailer may adopt the ECSP role and provide energy to the local market and use the local market flexibility to its own needs (e.g. correcting portfolio imbalances and optimising energy sourcing). Information needs of the retailer are presented in Fig. 3.

Fig. 3 Information exchange between retailer and market players [10]

4 Changing legislation

Some of the challenges named in the previous sections are likely to be mitigated once the new legislation included in the 'Clean Energy for All Europeans' package will be transposed into legislation of the member states. For example, Article 17 of the recast Electricity Directive 2019/944 [4] requires the member states to ensure that TSOs and DSOs treat DR aggregators in a non-discriminatory manner alongside producers when procuring ancillary services. This should open new markets and offer new revenue streams for local communities.

The recast Electricity Directive introduced the term 'citizen energy community' which was defined as a legal entity that "*is based on voluntary and open participation*" and "*has for its primary purpose to provide environmental, economic or social community benefits to its members or shareholders or to the local areas where it operates.*" Article 16 of the directive requires that members of such community are entitled to leave the community. Furthermore, they do not lose their rights and obligations as household customers or active customers. Thus, energy community members should be able to make an electricity supply contract with the retailer

of their choice, and simultaneously they should be able to benefit from energy community's resources, such as own generation. This implies that community members need to be able to access the retail market as individual customers and energy community cannot be a single customer.

Due to the novelty of the concepts of energy community and local energy market, most countries are only now starting to establish the legislation for them.

5 Conclusions

This paper has reviewed the potential interaction between local and open energy markets and analysed how the arrangements in the retail, wholesale, and ancillary service markets affect the local markets and their design. Due to differences in national arrangements, no "one size fits all" solution for organising local markets exists even within Europe.

At the moment, eligibility of resources varies between European ancillary service markets, in many cases limiting the potential revenue streams for local markets. However, the situation should level off once the requirements of the recast Electricity Directive 2019/944 have been transposed into national regulatory frameworks. The same directive clarifies also other questions related to the position of communities and local markets. For example, it impacts the relationship between local and retail markets as it requires that members of energy communities do no lose their rights as household and active customers.

In addition to the eligibility, also bid size requirements (in both wholesale and ancillary service markets) and trading fees may limit the opportunities of new types of service providers (e.g. third party ECSPs) to represent the community in the wholesale market. Furthermore, regardless of who represents the local market, utilisation of local resources will increase the information exchange needs. Several stakeholders – including the DSO – may procure local flexibility but the DSO will need information transactions between other stakeholders to ensure that grid constraints are not violated.

6 Acknowledgements

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