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A (not so) Independent Aggregator in the Balancing Market: Theory, Policy and Reality Check

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***Abstract*— The aggregator has been touted as the key enabler of active engagement of distributed energy resources and promises to contribute to greater economic efficiency in the European balancing markets by providing cheap sources of flexibility. This paper presents an empirical analysis of how aggregators organize themselves in relation to other market participants given the rules of the balancing market and the impact thereof on their participation. We reviewed how market design influences their choices by comparing three countries, Austria, Germany and the Netherlands, in the light of the goals set by the EU. Despite the EU policy drive to integrate aggregators, the participation of independent aggregators in the balancing market is so far limited. Relaxing the agreement requirements, allowing pool-based prequalification and standardizing compensation mechanisms unlocks more possible business models for the aggregator and may help create synergies among aggregators, suppliers and balance responsible parties.**

***Index Terms*— aggregator, balance responsible party, balancing market, market design, energy policy**

I. Introduction

The aggregator has been touted as the key actor to unlock flexibility from distributed energy resources (DER) and promises to contribute to greater economic efficiency in European balancing markets. Since balancing markets are often characterized by high market concentration, strategic behavior and high price volatility (e.g. [1]–[3]), aggregators' participation promises to boost competition levels and reduce balancing costs as a result. Although independent aggregators have already been entering energy markets both in the EU and elsewhere, their involvement has so far been limited. One of the reasons for this could lie in the balancing market design while the conditions for their participation differ across countries. Several researchers studied possible business models for aggregators in the Nordic market [4] and a few other European countries in project BestRES [5] but found that either not all models were allowed by existing regulation or improvements were needed.

We take this analysis further by analyzing how the participation of aggregators and their benefits to the balancing market depend not only on their number, the technologies they include in their portfolio but also on their level of independence. Their contribution is directly linked to their relations with other market actors (suppliers and balance responsible parties, BRPs) as emphasized in [6]. Market design affects these relations and, as a consequence, their degree of independence and choice of business models. This paper therefore investigates the question of how aggregators organize themselves in response to different market designs.

II. Methodology

To this purpose, we investigate the role of an aggregator from three different perspectives. First, we review the EU policy goals and the relevant regulatory documents such as the Clean Energy for All Europeans Package and the recently adopted Regulation establishing a guideline on electricity balancing (EBGL), identifying the main aspects of market design affecting aggregators. As a second step, we identify six potential setups, i.e. ways in which the relations among aggregators, suppliers and BRPs may be structured. With the help of these we then study the empirical evidence from three European countries, Austria, Germany and the Netherlands, which were selected as all of them apply the BRP model to system balancing and aggregators already participate in the balancing market. Finally, we determine which of the setups are currently applied as well as the way the main relevant aspects of market design affect the aggregator's incentives and choices of a setup and formulate policy recommendations to overcome existing restrictions.

III. Policy Perspective

At the EU level, efforts have been made to boost consumer engagement, non-discrimination and market transparency through the drafting of a comprehensive Clean Energy for All Europeans Package. The EBGL further strives to increase competition levels in the balancing market and ensure operational security in the most price-efficient way. An aggregator can become instrumental in contributing to these goals and is encouraged in the EU regulatory framework.

Notably, the recently proposed Directive on common rules for an internal market for electricity introduced two separate definitions for an "aggregator" and an "independent aggregator" [7]. The former is defined as "a market participant that combines multiple customer loads or generated electricity for sale, for purchase or auction in any organised energy market", while an independent aggregator is defined as one "that is not affiliated to a supplier or any other market participant" ([7], Art. 2 (14-15)). Recent EU regulation thus strives to create enabling conditions for independent aggregators to participate in the national markets.

These definitions do not preclude market actors from assuming more functions beyond their core activities and

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deciding what kind of resources on the supply and/or demand side will be included in their portfolio. Depending on a portfolio and market design, these activities can range from the participation in the wholesale markets, balancing market, other ancillary services or electricity supply of end users. According to the definition, the aggregator does not necessarily supply end consumers with electricity. They can also operate a so-called virtual power plant (VPP), which bundles small generation units for market participation. Besides, Article 4 of the Proposal for a Regulation on the internal market for electricity mandates everyone to be accountable for the imbalances they produce, either by acting as a BRP themselves or delegating these functions to a BRP [10]. That said, a market participant, a supplier or an aggregator, may or may not perform the functions of a BRP.

In the proposed EU regulation, pursuant to Articles 13 and 17 (3a) [7], independent aggregators are not obliged to seek the authorization of their customers' supplier or any other market participant. The Member States are required to adapt the regulatory framework by clearly defining roles and responsibilities, data exchange procedures and freeing aggregators from the obligation to compensate suppliers or generators ([7], Art. 17 (3b-d)). Financial compensation is permitted only provided that "one market participant induces imbalances to another market participant resulting in a financial cost" ([7], Art. 17.4). According to the EBGL, balancing energy bids can be assigned to several BRPs, for instance, the BRP of a supplier and the BRP of an aggregator. These have to calculate and exchange the corresponding incurred costs of imbalances ([9], Art. 18, 4(d)).

Therefore, the recent EU regulation highlights two main market design aspects that can affect the aggregator's incentive to participate in the balancing market and their choice of a business model, namely:

- Agreement requirements: Requirement to obtain an authorization of a BRP or a supplier is imposed in some EU countries and can effectively hinder the market entry of aggregators [8].
- Additional charges placed on aggregators: Such charges may include high administrative or network fees, risk or other premiums required to compensate a customer's supplier or the BRP.

IV. Theoretical Perspective

The question of how the relations with other market participants are structured is relevant since new market participants do not only transform the market landscape but also affect the roles and activities of the existing stakeholders in the sector. In line with the definitions in Section 3, the relationship between aggregators, suppliers and BRPs can be structured in a number of ways. This is based on whether an existing supplier takes over the functions of an aggregator or if an aggregator is a standalone independent actor; whether a supplier or an independent aggregator assume the functions of a BRP and whether an aggregator can pool resources from multiple supplier or BRP portfolios. The decision tree used to identify possible setups is illustrated in Figure 1.

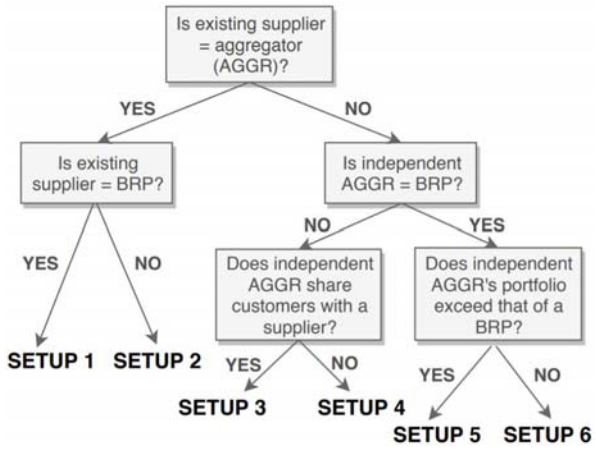

Figure 1. Decision tree used to identify possible interrelational setups between aggregators, suppliers and BRPs

Based on these variables, six theoretically possible setups were defined in [6] and will be briefly explained below. The setups, as is illustrated in Figure 2, are ordered according to the degree of independence and flexibility with which an aggregator can choose a portfolio and the scope of his activities from the supplier-aggregator setup to the most independent aggregator setup. Figure 2 shows a spectrum of options: the functions of market participants are fluid and can evolve in the future and definitions may start overlapping because of an increasing number of common features. As a result, the relationship among different market parties can become more competitive or more symbiotic.

In Setups 1 and 2, the role of an aggregator can be taken up by a supplier as an extension of their business model, taking profit of their sector expertize and the existing customer base. It is common for a big supplier to form their own balancing portfolio of generation units and consumers (Setup 1) or for a daughter company to join the portfolio of the parent company (Setup 2). Such a supplier-aggregator can pool supply-side and demand-side resources to provide an array of services, including balancing, and realize economies of scale.

Under Setups 3, 4, 5 and 6, an aggregator is an independent third-party actor, as per definition in the Clean Energy Package [7]. An independent aggregator could potentially target several customer groups, thus building a more flexible portfolio, and combine a number of functions. Following this logic, a company pooling resources across energy systems or a sector-external company linking telecommunications with energy services for data management could be well-positioned to perform the role of an aggregator under Setups 3, 4, 5 and 6. Another possible actor, a local energy community, introduced in the Clean Energy Package, could be operated by an independent aggregator (Setup 6) and provide local system services along with balancing services ([7], Art. 16). However, the business case largely depends on the applicable grid tariffs and taxes.

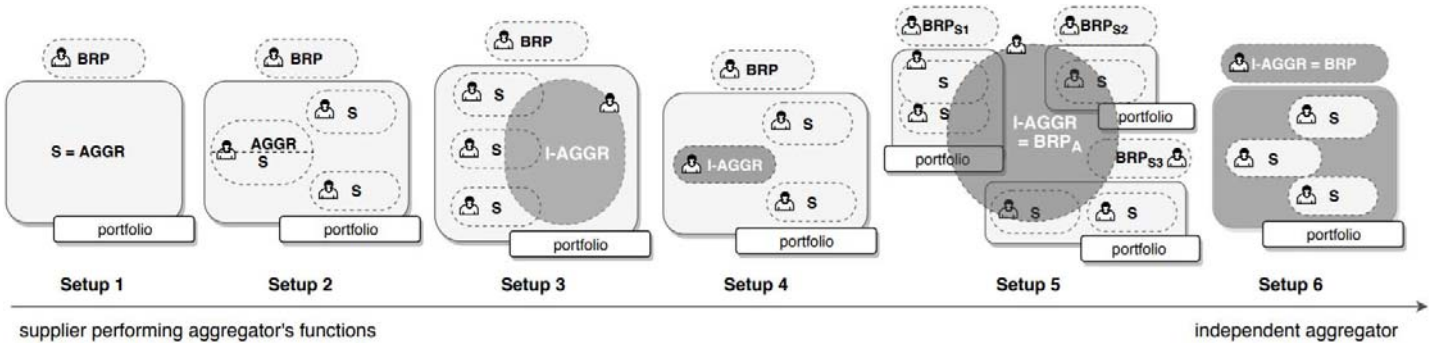

Figure 2. Possible interrelational setups among aggregators (AGGR)/ independent aggregators (I-AGGR), suppliers (S) and BRPs.

From the point of view of cost allocation, an aggregator can have a double-edged-sword effect. On the one hand, an aggregator with flexible DER can assist the BRP in optimizing their portfolio and hedging against imbalance costs (Setups 2, 3, 4, 5). On the other hand, if an aggregator's portfolio includes a lot of variable renewables or small loads, it can turn out more difficult to avoid imbalances and an aggregator can potentially aggravate the balancing position of associated suppliers (Setup 3) and BRPs (Setups 3, 4, 5). In particular, the participation of an independent start-up aggregator can be challenging both from the point of view of customer acquisition and from a substantial investment, particularly into a reliable and advanced ICT infrastructure. Inappropriate cost allocation can result in creating value for certain parties, aggregators and their customers, while negatively affecting the rest of the players as balancing costs are at least partially socialized through system charges [11]. In contrast, applying to perform the tasks of a BRP (possible in Setups 1, 5 and 6), an aggregator would bear all the costs of imbalances. This requires a contract with a TSO and more prerequisites to fulfill in return for a better overview and control of the available portfolio resources.

An aggregator's portfolio can be part of a BRP's portfolio (Setups 2, 3, 4) or draw their resources across several BRP portfolios (Setup 5). Such setups foresee an ex-post imbalance calculation with the involved BRP(s), which raises complexity from the point of view of financial transactions and compensation. In order to perform their tasks efficiently, an aggregator needs a robust enough DER portfolio. If an aggregator is restricted to one specific BRP portfolio, they may not have a sufficiently big pool of resources and subsequently their potential might be limited (Setups 2, 3 and 4). Notably, Setup 5 foresees an option for an aggregator to act outside a single balancing portfolio and to cooperate with several suppliers' BRPs, benefitting from a bigger, more flexible portfolio. The main challenge under this setup consists in defining proper arrangements for the imbalance settlement among the actors involved.

Finally, one of the main yardsticks of an efficient market is successful mitigation of market power. In case an incumbent supplier providing balancing services decides to assume the role of an aggregator, the issue of market concentration in the balancing market remains unsolved although the goal of greater customer involvement in the market can be accomplished nevertheless. Even when a new independent aggregator enters the market and achieves a dominating position with a vast flexibility portfolio, as would be possible in Setups 5 and 6, the competition levels can deteriorate. These setups echo the idea of a centralized aggregator described in [11].

The described benefits of aggregation as well as potential tradeoffs were matched with the analyzed setups in Table 1.

V. Reality Check

Given EU policy goals and prescriptions for the participants' roles and the associated market design, it is important to evaluate how aggregators organize themselves locally. This Section deals with the setups applicable in the countries of study, the reasons for aggregators' choices and implications thereof. We further discuss constraints aggregators face due to market design. As pointed out in the previous sections, the aggregator's freedom and attractiveness of the business case depends on such market-design-related factors as the possibility to pool units from different BRP portfolios, agreements required with other market participants and applicable charges, which are approached differently in individual countries. This means that while some setups maybe allowed, these restrictions make their choice *de facto* unattractive for an aggregator. This will help us to understand whether national market designs allow aggregators to develop their full potential in the balancing market.

A. Austria

In Austria, all of the described configurations can be implemented and do not run into regulatory barriers [6]. It is the aggregator's prerogative to choose the setup they deem most optimal. Five aggregators (out of which three are independent) have been prequalified to participate in the balancing market.

The relations between the independent aggregator and other market participants as well as compensation mechanisms are not stipulated in the market design rules, thus the specific conditions vary from one agreement to another. Furthermore, the Austrian regulator does not place any restrictions on the composition of the pool and does not specify who is allowed to perform the role of an aggregator. Cross-BRP pooling is allowed in Austria, which gives an independent aggregator more flexibility in setting up his DER portfolio (Table 1).

Setup	Benefits	Potential risks / disadvantages
Setup 1 S = AGGR = BRP	Economies of scale, portfolio diversification, new services (e.g. spot and balancing markets)	No contribution to increasing competition in the balancing market
Setup 2 S = AGGR ≠ BRP	More services, minimization of imbalance costs through a "flexibility buffer" from DER	No contribution to increasing competition in the balancing market
Setup 3 I-AGGR ≠ S ≠ BRP	Customer engagement, activation of the demand side; new services	Possible difficulty for an aggregator to achieve a marketable portfolio size; potential conflicts of interest with the supplier or BRP due to increasing imbalance volumes; potentially, higher complexity
Setup 4 I-AGGR ≠ S ≠ BRP; $BRP_S \neq BRP_A$	Potentially higher competition levels in the balancing market; innovation; potentially: optimization of a BRP's portfolio	Possible difficulty for an aggregator to achieve a marketable portfolio size; potentially higher imbalance costs for the BRP
Setup 5 I-AGGR ≠ S ≠ $BRP_{S1,S2,Sn}$, AGGR = BRP_A or AGGR ≠ BRP_A	Flexible portfolio composition; contribution to competition in the balancing market; innovation; economies of scale possible	High costs of portfolio optimization for the aggregator; high complexity as financial compensation with suppliers or BRPs necessary.
Setup 6 I-AGGR ≠ S = BRP_A	High flexibility in portfolio composition; more services; suitable for a Local Energy Community ([7], Art. 2(7))	Cost of BRP portfolio management Potentially, exertion of market power in case of a big centralized aggregator [11]

TABLE I. OVERVIEW OF BENEFITS AND MAIN CONCERNS LINKED TO THE IDENTIFIED SETUPS

The example of currently active aggregators shows that pooling of small generation facilities is more practicable than demand response (DR). Only two aggregators in the electricity market included industrial DR in their portfolios. Thus, the goal of greater consumer engagement has been fulfilled only marginally. Another specificity of the Austrian market is that only those RES that do not obtain their revenues under a support scheme are allowed to generate additional revenues through the participation in the balancing market.

In the balancing market, an aggregator is under obligation to coordinate his activities with the respective BRP(s). Besides, the supplier's consent is obligatory if the independent aggregator and supplier belong to different BRP portfolios (case of Setup 5). An aggregator therefore has an incentive to form an own balancing group that avoids potential conflicts of interest with other market participants as well as the need to carry out financial adjustments with the BRP or supplier or seek their consent. This explains why the aggregators in Austria prefer setups at the ends of the scale in Figure 1, under which either incumbent suppliers take over aggregation (Setups 1 and 2) or an independent aggregator concentrates all DER in one self-managed balancing portfolio (Setup 6), as the analysis in [6] showed.

B. Germany

Similar to the Austrian case, German market design does not limit market participants in the choice of a setup or the type of resources they include in the pool. In Germany, 8 independent aggregators have been prequalified to participate in the balancing market for one or several products with portfolios including a variety of DER, such as CHPs, industrial loads and power-to-heat, as well as RES generation. Energy storage is gaining importance in aggregation activities [12] and has already been implemented by two German aggregators. RES providers under a market-based "direct sale" (Direktvermarktung) mechanism are allowed to generate additional profits from participation in the balancing market.

Demand response from industrial and commercial providers is much more actively used in the German context, which can be explained by the effort of the regulator, Bundesnetzagentur (BNetzA), to minimize the number and extent of contractual relations needed for consumers to carry out their activities in the balancing market either individually or with the help of a "third-party" aggregator. BNetzA, specifically addressed the "intermediate" setups where an aggregator is not at the same time a supplier or a BRP (Setups 3, 4, 5) with reference to the provision of balancing products from final consumers[1] [13]. According to the decision, an end consumer shall notify his supplier of his intention to provide balancing services. A consumer's supplier yet cannot deny this right to a consumer or aggregator unless this has been explicitly stipulated in the supply contract. No obligation of notification or approval is foreseen with respect to the BRP as neither the end consumer nor their associated aggregator has a direct contract with them. Unless specified, an end consumer can provide balancing services through the BRP of the aggregator and the supplier's BRP is under obligation to "open their group" [13]. The German regulator thus attempted to overcome potential barriers to entry mentioned above making intermediate Setups 3, 4 and 5 more viable and their choice more common among German aggregators.

Concerning the compensation mechanisms between market participants, it has been argued that aggregators' activities cause a higher administrative effort for the BRP due to schedule adjustments and exchanges as well as higher risks for the suppliers of those customers whose units are used for the provision of balancing energy. Following the EU guidelines described in Section 3, BNetzA decided against applying additional charges in these respects. However, while no risk premiums are foreseen, suppliers can still charge customers and, consequently, aggregators disproportionately for schedule exchanges, which can arguably act as a *de facto* deterrent to their participation in the balancing market. For this reason, in Germany, it is more economically sensible for an aggregator to engage in electricity supply of end consumers to avoid conflicts of interest and possible barriers to entry.

C. The Netherlands

Similar to the other two markets, the Dutch market actors are offered extensive pooling options to participate in the

[1] Specifically, automatic frequency restoration control (aFRR) and manual frequency restoration reserve (mFRR)

balancing market. Yet, so far no aggregators are providing *standard* balancing products in the country. The only aggregator poised to do so is German Next Kraftwerke through a new partnership with Energie365[2]. Main reason for this lies in the fact that bidding in the Dutch balancing market is conducted through the BRP. This means that an explicit agreement of a BRP is required to allow an aggregator to submit their bids. Besides, for standard balancing products, aggregators so far cannot deliver services from portfolios of different BRPs (Setup 5), limiting their potential to contribute to system balancing.

As long as an aggregator cannot assume the role of the BRP themselves – and in so doing take sole responsibility for imbalances – they cannot participate in the balancing market without BRP intermediation, excluding Setups 3 and 4 from their options. Yet, the costs of management of a balancing portfolio are not trivial and should be evaluated, whether a BRP role makes economic sense. Besides, assuming the role of a BRP, an independent aggregator has to ensure that the portfolio is properly dimensioned to avoid high imbalance volumes. Imbalance prices create a tangible risk for market participants, as these, unlike in Germany or Austria, are published very close to real time. As a result, Dutch aggregators mainly fulfil an ancillary function providing flexibility for BRP's portfolio optimization.

Notably, in contrast to standard balancing products, aggregators are active in the provision of so-called emergency power (Noodvermogen) with about 5 aggregators who are allowed to pool resources from different BRP portfolios for this purpose. Emergency power is a specific balancing product predominantly provided by large industrial consumers. The Dutch transmission system operator procures emergency power on a yearly and quarterly basis, which guarantees fixed revenue flow but at the same time if the aggregator was not chosen, the pool will be inactive for an entire year or quarter. The aggregator should have a bigger pool than stated in the contract with TenneT to ensure it has a flexibility buffer in case of non-delivery, which is heavily penalized by TenneT. This therefore limits the choice of a setup to Setups 5 and 6 where aggregators do not run into portfolio constraints.

These considerations make it easier for existing suppliers with established BRP relations to take up an additional aggregation function (Setups 1, 2) and make possibilities for independent aggregation beyond emergency power limited.

VI. Results and Conclusions

EU policy goal to encourage independent aggregation relies on the premise that their growing number can improve the performance of the balancing market by bringing more flexibility into the market, maximizing competition and ultimately reducing the cost of balancing. We showed that the relations among market participants, suppliers, aggregators and BRPs, can be set up in a number of ways and influence the modalities of aggregators' participation in the balancing market. All the identified setups (Figure 2), as shown in Table 1, involve tradeoffs; the extent to which they materialize and the aggregator's choice of a setup depends on market design in individual countries. It includes such key aspects as obligation to conclude agreements with other actors or compensation mechanisms in place. The case study of 3 EU countries shows how these are approached differently and are so far not entirely aligned with the recent EU regulation described in Section 3.

The specifics of market design in individual countries affect the freedom with which independent aggregators can choose the most optimal setup for themselves and realize their potential in the balancing market. While ever more aggregators have been sprouting in the German balancing market, their performance in the Dutch balancing market is negligent (except for emergency power). Required intermediation of other market actors, namely BRPs, in the Dutch balancing market, reduces their incentive to participate. The incumbents, in turn, are in a better position to include aggregation into their activities as a promising business model (Setups 1 and 2). Stringent requirements to obtain other market actors' consent may either limit the range of services they can provide from flexible DER or the extent to which they are incentivized to engage suppliers' customers. In the countries where such contractual agreements are imposed on aggregators, there is an incentive for market participants to consolidate their activities by assuming multiple roles, common for Austrian aggregators. Assuming more functions for a single actor, i.e. choosing a setup at the extremes of the scale in Figure 2 (Setups 1 and 6), simplifies cost allocation and reduces conflicts of interest. It is however also linked to higher costs and does not necessarily contribute to maximizing competition in the balancing market. Relaxing applied agreement requirements, similar to the recent measures taken in Germany, unlocks the intermediate setups (Setups 3, 4 and 5) and helps create synergies among aggregators, suppliers and BRPs.

To fully exploit the potential of aggregation of flexibility, independent aggregators should be acknowledged and encouraged by explicitly allowing Setups 3, 4, 5 and 6. This would expand the range of business models available to them and therefore maximize their contribution to the balancing market. In particular, reliance on intermediate Setups 3 and 4 will lead to more symbiotic relations with other market actors while the choice of Setups 5 or 6 can foster competition among existing suppliers and new independent aggregators.

To improve the situation of aggregators in EU Member States, independent aggregators should be allowed to perform their tasks on par with the established market actors and given freedom to choose the most optimal setup. It is possible to unlock all possible setups by lifting agreement requirements to guarantee aggregators' actual independence and allowing pooling DER beyond a single BRP portfolio. Finally, uniform compensation mechanisms should ensure that aggregators are responsible for the produced imbalances but are not unduly disadvantaged by additional charges.

[2] https://www.next-kraftwerke.com/news/next-kraftwerke-netherlands-virtual-power-plant

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