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Market integration or bids granularity to enhance flexibility provision by batteries of electric vehicles

Olivier Borne[a,*], Yannick Perez[b], Marc Petit[a]

[a] GeePs, CNRS UMR 8507 CentraleSupélec, UPSud and UPMC, 91192 Gif-sur-Yvette, France
[b] RITM Université Paris-Sud, and LGI, CentraleSupélec, 91192 Gif-sur-Yvette, France

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ABSTRACT

For several years the European Commission has been advocating the creation of integrated electricity markets. After the wholesale market, the establishment of a common reserve market has begun with cooperation related to a Frequency Containment Reserve (FCR), a common platform for the cross-border procurement of primary reserves. The aim of this paper is to study the implications of the decision of the French regulator to join the FCR Cooperation. Two aspects will be analyzed: 1) the cost of procurement and the increase in social welfare thanks to cross-border procurement and 2) implications for the arrival of new entrants such as aggregators of distributed resources (Electric Vehicles fleet are considered in our survey). We conclude that joining the FCR Cooperation will have a negative impact on the participation of aggregators and might not play a useful role in lowering costs for the procurement of reserves. We propose new rules to solve these issues.

1. Introduction

Due to major concerns about climate change, governments undertook during the COP21 in Paris to reduce their greenhouse gas emissions with a view to achieving a 2 °C warming target. In the electricity sector, decarbonization would be achieved by switching from fossil fuel-based generation to renewables-based generation, mainly wind and solar. To reach this target, the International Energy Agency (IEA) has calculated that 60% of the electricity generation should come from Renewable Energy Sources (RES) by 2040 (International Energy Agency, 2016a). In the transportation sector, this target would be achieved by promoting zero-emission vehicles such as Electric Vehicles (EVs). The IEA has set a target of 140 million vehicles on the road by 2030 in line with the 2 °C scenario (International Energy Agency, 2016b).

These two trends will create major issues in the entire value chain of the electric power system; for example, balancing generation and consumption will be more challenging, due to the volatility of RES generation. Transmission System Operators (TSO), who are responsible for managing this balance, have contracts with different players - generators or consumers, called Balance Service Providers (BSP), who must respond to signals to re-establish balance. It is assumed that reserve requirements will increase in the coming years due to the increase in variable RES in the energy mix (Hirth, Lion Ziegenhagen, 2015) (Brouwer et al., 2014). Moreover, while centralized units, i.e. nuclear[1] or fossil-fuel power plants are challenged by decentralized generation, new sources of flexibility should be considered. Indeed, there may be periods when electricity is almost exclusively produced by decentralized resources and few spinning centralized units are available (Bertsch et al., 2016) (Ummels et al., 2007).

Distributed energy resources (DER), such as variable decentralized generation, storage, EVs and active consumers, are technically able to provide such a type of reserve (Codani, 2016; Vandael et al., 2013; Galus et al., 2011). Depending on their technical characteristics, they would be best suited for one or the other market (Eid et al., 2016). However, economic and technical rules and regulations are not adapted to energy provision from these types of new players and the future revenues of the aggregators depend on these rules to a great extent (Codani et al., 2016).

Rules designed for the provision of reserves are therefore essential to ensure that the TSOs can purchase all the reserve they need at the lowest cost. Rules can impose administrative barriers, not allowing consumer units, storage systems, etc. to participate in the market. Rules might also be designed in a way that restricts the participation of resources of this type. The existence of these barriers has been identified for demand response in the US electricity markets (Cappers et al., 2013). The impact of such rules has been analyzed in Borne et al. (2018). The authors develop a framework to identify different types of

* Corresponding author.
E-mail addresses: Olivier.borne@centralesupelec.fr (O. Borne), yannick.perez@u-psud.fr (Y. Perez), marc.petit@centralesupelec.fr (M. Petit).

[1] See Cany et al. (2016) for more information on flexibility provided by nuclear units.

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barriers to entry. This framework can be used as a basis of assessment when a country decides to change its market design with a view to increasing or decreasing barriers to entry in these markets.

In October 2016, France decided to change completely its market design for the provision of Frequency Containment Reserve (FCR) (Commission de Régulation de l'Energie, 2016), which gives the opportunity to test this analytical framework on a real case. Before the change came into force, the French TSO (Réseau de Transport d'Electricité, RTE) procured reserves through mandatory provision by centralized large units, with an annual fixed regulated tariff. Other players could sell reserves to large units, after a pre-qualification agreement with RTE, with a negotiated price. The French regulator had asked RTE to change its rules to implement a call for tender, to comply with the requirements of the ENTSO-e Network Code (Commission de Régulation de l'Energie, 2015).

Several choices were possible; one of them was to create a national call for tender, based on original French rules. The second option was to join an existing reserve market. RTE decided to join the FCR Cooperation. This Cooperation is a common platform for Germany, Switzerland, the Netherlands and Belgium to procure FCR. The French regulator pointed out the limits of this option: the duration of the reservation product (an entire week from Monday 0 a.m. to Sunday 12 p.m.) was judged too long by the regulator and some of the French players (RTE, 2016a). However, the regulator considered that it could be in a better position to change the rules from within the Cooperation and that market integration was a priority to procure reserves at the lowest cost.

The aim of this paper is to assess this arbitrage. In Section II, we will look in detail at the former French market design and the FCR Cooperation market design and analyze this change using the framework defined by Borne et al. (2018). We will then look at the rationale behind market integration. Section III is a case study on an aggregator of Electric Vehicles to assess the implications of the French decision and propose some improvements to the FCR Cooperation market design. Section IV gives an overview of the on-going consultation process in the FCR Cooperation for changes in the rules, and the paper is concluded in Section V.

2. Analysis of the french participation in FCR cooperation

In this section, we will first give a description of the former French market design for FCR delivery and of the FCR cooperation market design. We will analyze this change using the framework presented in Borne et al. (2018) to understand its implications for aggregators.

2.1. French market design before 2017

The former French mechanism (RTE, 2016b) is described in Fig. 1. It is characterized by an administrative tariff for the delivery of FCR and automatic Frequency Restoration Reserve (aFRR). It is mandatory for each generation unit to provide reserve at a yearly flat tariff. The total amount of reserve is allocated by RTE across the different BSPs pro rata their production. RTE gives the schedule of delivery one day ahead, with a 30 min' time-step.

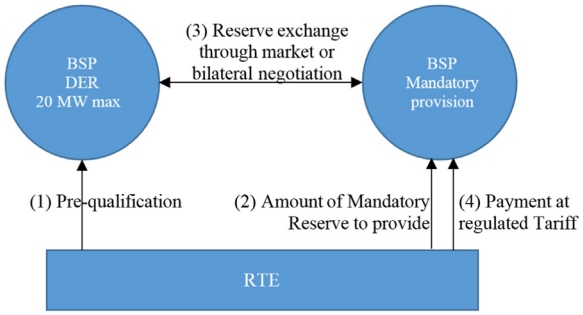

Fig. 1. Organization of FCR procurement in france before 2017.

Other players – e.g. storage, consumption units and distributed generation – can provide reserves if they pass the prequalification test. However, the total amount of reserve that can be prequalified is limited to 40 MW for FCR and aFRR, and to 20 MW for a single BSP. This type of player cannot be pooled with generation units. The allocation of these certifications is based on a "First Come, First Served" rule. When prequalified, these players can sell their reserve on a secondary market organized by RTE or via bilateral negotiation, which is notified to RTE. The exchange of reserves can be notified until one hour before delivery.

2.2. FCR cooperation market design

FCR Cooperation is a joint call for tender for FCR procurement. It is based on the German market design for FCR procurement ("regelleistung.net," 2017). Switzerland was the first to join the German platform in 2012, followed by the Netherlands in 2014, Austria in 2015, Belgium in 2016 and finally France in 2017. FCR is procured through a weekly call for tender, and the market clearing is done each Tuesday (6 days ahead). Procurement is made for the next week with a unique product (symmetric, from Monday 0 a.m. to Sunday 12 p.m.). Relations between the stakeholders and the platform are described in Fig. 2.

National TSOs are still in charge of prequalification tests and contracts with reserve providers (post assessment, penalties for non-delivery), which are not harmonized among countries. France keeps its limit of 40 MW of DERs that can be prequalified by RTE. TSOs give their reserve requirements to the platform. BSPs can make offers on the platform until market clearing. Offers are selected on the basis of their Merit-Order. Exports are limited to 30% of the size of the national reserve (15% for France) whereas imports are not limited. The exchange of reserves between BSPs from different countries is not allowed. However, France retains its notification mechanism, which still allows French BSPs to exchange reserves through bilateral negotiation or secondary market. BSPs are remunerated using the "pay as bid" rule. Costs are allocated to the TSOs pro-rata their reserve requirements at the average cost of reserve for the overall Cooperation. We will now analyze the implications of the French decision for aggregators.

2.3. Implications for aggregator

The framework developed in Borne et al. (2018) gives an opportunity to understand the impact of changes in the rules of the FCR procurement on aggregators. This framework is based on an analysis of the rules governing the provision of reserves, divided into three different modules where rules are identified (Table 1). They are described, and implications for aggregators are analyzed.

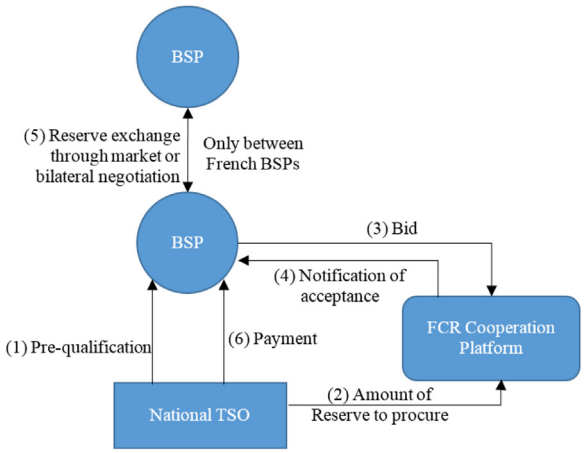

Fig. 2. Organization of FCR procurement in the fcr cooperation.