Demand response integration in the electricity market and settlement - Executive Summary

Learning from France, UK, California and PJM experience

E-CUBE STRATEGY CONSULTANTS

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This study analyses valuable insight from four of the most mature demand response markets (France, UK, California and PJM) representing ~40% of the global DR market. It is based on 27 industry interviews (DR pure-players, utilities, ISO, TSO, DSO, regulators) and a comprehensive review of these markets and their evolutions over the last years.

It underlines that multiple models, presenting extensive differences, are possible:

- **France** (~3GW): DR is currently done thanks to a tender offer by the RTE, the local ISO, in order to be used through tertiary reserves. However, a new framework, specific to DR, is currently drawn for the next summer. This defines new possibilities for DR: Energy Markets, future capacity markets, DR subsidy, and a set of settlement rules to represent better the real value of DR. E-CUBE was mandated as experts to assist the French Regulator for its 2013 demand response reform[1].
- **California** (~3GW): DR is done at two different levels:
  - ◊ The utility level, where different programs allow residential and non-residential customer to participate to DR and reduces the peak demand
  - ◊ The ISO level, where important consumers (>100kW) are considered as generation plant and are able to bid into the energy markets.
- **UK** (~1,2GW): Currently, this is mainly done with the balancing mechanisms by National Grid. However, the situation is evolving with a consultation from Ofgem on a future organisation for DR and an emergence of DR for the distribution grid cases.

Demand Response (DR) is widely seen as a competitive solution for the management of the electric grid. However its integration in the electricity market and the settlement is a complex issue.
DR integration in the electricity market is defined by five key parameters:

1. Valuation Markets of Demand Response (Energy, Capacity, Balancing reserves, Distribution Grid services)

Demand Response (DR) used to be mainly valued on the balancing market or internally by utilities. However this situation is rapidly evolving. National regulators (e.g.: FERC for the USA, Ofgem for the UK, CRE for France) are pushing for a deeper integration of DR in the wholesale markets. The wholesale energy markets are becoming another important revenue source, with the payment of the full price being made commonplace in the US (FERC Order 745). In France, a framework for a direct integration of DR in the day-ahead and real-time market is being finalized. Concurrently, the wave of capacity mechanism deployments in Europe natively integrates DR. In the USA, PJM (an East coast ISO) created such market in 2007. These markets induced a massive DR growth from 2 GW to ~15 GW (10% of total capacity) in 5 years. Moreover, this market is concentrating 90% of the DR revenue at PJM level.
Most recently another source of valuation is emerging: the DR use as a flexibility asset for distribution grids. The economics rely on delay-

1. Link to our report (in French) : « Etude des avantages que l'effacement procure à la collectivité et de leur intégration dans un dispositif de prime », 6 June 2013 : http://www.cre.fr/content/download/10329/99441/version/1/file/130606_RapportConsultant_AvantagesEffacementCollectivite.pdf

ing massive grid investments with peak shaving. Beyond experimentation, first real-business examples start to appear. For instance, ENWL (a British DSO) is creating a local DR market through a tender offer in order to delay specific investments which lead ENLW to value up to 74€/kW the first year.

2. Demand Response specifications (duration, activation per year, response time)

Initially, DR constraints mirrored generation requirements on balancing markets. Hence DR was required to have a short response time (lower than 30 minutes) but the number of activation per year and the total length of the call were low (e.g. ~50 hour/year in UK).
The opening of larger and less constraining markets to DR changed the game. The PJM case is one illustration among others of this shift. At first the capacity market requirements were aligned on balancing market 2 hours response time at PJM and the number and duration of the calls were limited (10 calls of 6h per summer). In 2011, PJM created new capacity products (Annual and Extended Summer products, delivery starting in 2014) with unlimited number of longer (10h) calls.
The gradual reduction of the constraints on demand response strongly increases the potential of DR but also transfers risks, like volume of activation, from the system operator to the demand response provider.

3. The supplier back-payment scheme

During a DR event, the consumer supplier will produce as if there were no DR, but it will not be paid by its consumer since the latter didn't consumed directly the energy but sold it on the DR market. Theoretically a specific treatment should correct those deviations. This is called the supplier back-payment. E-CUBE market study shows that its implementation is a highly complex issue. The questions that arise are the following: Who is credited the energy provided by DR? Who is paying for it? How the load responsibilities of the supplier are changed or not? How the supplier is compensated for the loss from the sale of energy? Three different answers can be identified:

- **Imbalance based back-payment scheme**: The supplier is getting paid at the imbalance price thanks to its load responsibility reduction but loses the retail price. The consumer/DR provider is paid by the market used (e.g. Capacity market or balancing market). An agreement may be possible between the supplier and the consumer/aggregator to correct the economic defects but is not enforced. This situation is not perceived as satisfying but still exists in many countries, mainly because it requires almost no implementation efforts. For instance, this is currently the case in the UK for DR on the STOR balancing market, and was the case in France until 2013 for residential DR.
- **Net Benefit Test Scheme**: Order 745 (April 2011) of the FERC fixed the compensation of the DR at full spot price for its energy (as generation), and decided that the costs would be allocated on all suppliers and actors that export energy at the *pro-rata* of their load. However, this compensation should only take place when it is beneficiary for the end costumers (when the spot price is above the *net benefit price*). An intense debate has been done on the economic efficiency between this solution and the next one.
- **Structured back-payment Scheme**: Contrary to the FERC Order, this scheme set up the compensation of DR at the spot price minus the retail price (which is the financial value of an unexercised call option). Thus, the non-consumed energy is credited to the aggregator/consumer and charged to the supplier (concerning the settlement), but the former compensate the supplier at the retail price. The goal of this scheme is to be neutral for the supplier and the wholesale market, but it requires a complex mechanism. It is being implemented in France and a similar scheme existed at CAISO and PJM before Order 745.

The FERC Scheme and the true scheme are inherently different, the first one considering DR as a generating capacity, whereas the second one as an unexercised call option.

4. The measurement and integration in the settlement

Contrary to generation, the measurement of DR is not straightforward. Apart from the backup generation, a specific methodology has to be defined depending on DR and settlement requirement, and the data used may require specific metering system. Those choices have a significant impact on the cost and potential of DR. Moreover, this can break the monopoly of the metering responsibilities (e.g. the DR provider install another meter in parallel of the DSO/utility one) and the management of the balancing. Two different issues arise:

- **The meters**: Two possibilities exists: either a meter is required for each DR site, with a specific time step, such as one minute (UK, France, due to its use in balancing mechanisms) or one hour (PJM); either no meter is required and therefore a statistical study is used (e.g. Direct Load Control on PJM, Dynamic profiling on CAISO). This last case is widely use for AC cycling in the USA and allow a fast development in residential DR but could allow free-riding with players benefiting of the DR done by others.
- **Calculation of the baselines**: In order to calculate the energy provided by DR, a baseline is required. Its calculation should theoretically be specific to each usage: an electric arc furnace and a residential customer do not have the same load profile. For instance, PJM is provides 6 methods for the hourly baseline for the capacity and 8 references for the hourly energy calculations; the choice is open as long as the accuracy met the criteria (error lower than 20%). In contrast, in the UK, only one baseline is available for the variable loads. Furthermore, the choice of including or not the rebound effect is important, especially in residential DR. Three methods are currently discussed in France, one being specifically adapted for the residential DR, integrating a part of the rebound effect.

5. Subsidy schemes to support demand response development

In order to accelerate DR development, regulators and governments may implement subsidy schemes based on DR positive externalities (reduction of grid losses, reduction of greenhouse gasses emissions, energy savings, etc.). Such a scheme is currently being implemented in France, where a premium is to be added to the compensation of demand response. It is not a one-shot specific initiative as it will cover all DR sources (industry, residential) and be technology neutral. The regulator mentioned an average premium of ~15€/MWh and up to ~30 €/MWh. This subsidy will be paid by the CSPE, a tax on all electricity consumers that is already paying the Feed-in-Tariff for distributed generation.

These five key-parameters define the DR development pace and the quality of its integration in the electricity market. A rigid integration with high constraints would strongly limit the DR market growth. On the contrary, too low requirements could vigorously disturb the electricity markets, the settlement processes and its quality, the system security, and finally induce high costs for a limited value service.

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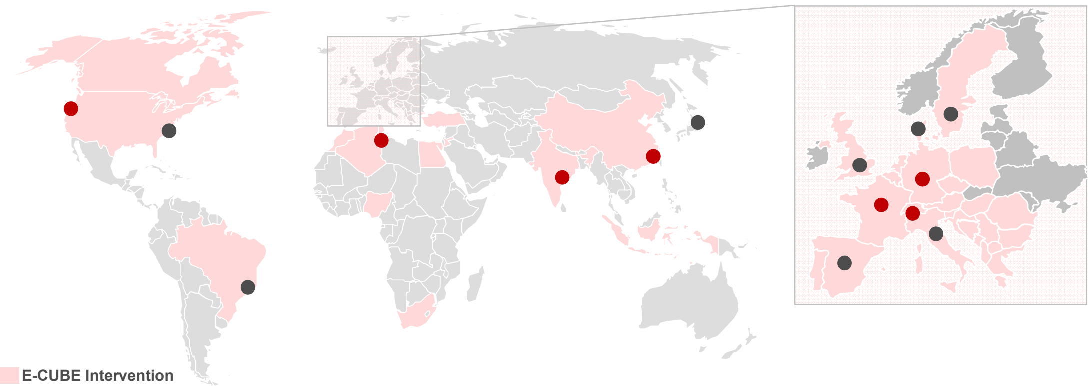

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