HOW DSO COULD FACILITATE SYSTEM OPTIMIZATION IN NEW MARKET MECHANISMS FOR DISTRIBUTED RESOURCES

Céline SALON
ERDF - France
celine.salon@erdfdistribution.fr

Oliver HUET
ERDF - France
olivier-o.huet@erdfdistribution.fr

François BLANC
ERDF - France
francois.blanc@erdfdistribution.fr

ABSTRACT

The paper presents the role of DSOs in future energy, capacity and balancing markets. DSO will have a role of market facilitator for decentralized generation and demand response, and will enable local optimization while fulfilling its traditional mission of safety of distribution networks.

The French electric system faces two challenges:
- A steady growth of peak demand at system level and on local networks, which can be aggravated by the upcoming of Electric Vehicles
- Growth of the proportion of intermittent and decentralized generation in its electric mix.

It is therefore of high importance that the electric system rely more and more on decentralized generation and demand response to address these balancing issues. Since these resources are connected to the distribution networks, DSOs are key to contribute to the management of a local system as part of a national optimization:

- *DSO is a technical contract holder with network capacities*
- *DSO collects information regarding the Balancing Responsible Party and manage metering data*
- *DSO supervises flows on its network and is responsible of its safety,*
- *DSO is an independent party with non-discrimination objectives*

DSO plays therefore a key role in the creation and handling of the aggregates that can be traded on these markets at 3 key times: certification, activation and evaluation.

Based on its experience, ERDF shows the benefit for the stakeholders of its key contribution.

INTRODUCTION

The evolution of the electric system in Europe will be important in the next twenty years. All countries in Europe have plans to increase renewable energies share in the energy mix to meet or overpass 20/20/20 target. The application of the European energy efficient directive includes a flagship measure to reduce of 1.5% of energy consumption per year. New technologies of heat pump or electric vehicle will also eventually modify load profiles. So, both generation and consumption patterns will change drastically in the near future.

By 2030, the national electric association UFE has forecasted for France in its prospective scenario more than 9 million electric or plug-in hybrid vehicles and 60 GW of new intermittent renewable generation. This represents more than 60% of all new generation capacity built before 2030. The French TSO predicts that by 2025, more than half of new capacity will be on distribution networks.
By 2030, the need for capacity on balancing markets is expected to double [1] in France from 3 to 6GW, due to a wider proportion of intermittent renewable energy in the electric mix. More than 85% [2] of that intermittent capacity, producing fast fluctuating flows will be connected to distribution networks.
On the residential consumption side, ERDF forecasts more than 1 million of new connection requests before 2030 if the demographic rates stay steady in that period.

Network should therefore be adapted to meet these new demands. Distribution networks are especially at the forefront of this evolution since they offer limited statistical distribution to cope with rapid modification of energy patterns and because they are at the crossroad of offer and demand. Investments will therefore be needed to adapt the network architecture to the new energy flows and to reinforce the infrastructure where customers will settle. But smart technologies will also complement this adaptation by providing sophisticated solutions to address the new issues.

The first challenge will be forecasting energy. If intermittent energy forecasting methods are quite reliable on a large territory (such as in a country), these techniques lack today of accuracy to predict local energy pattern on day-before to intra-day timeframe. ERDF has developed a research, development and demonstration project to be able to include such smart prediction or other contingency tools when ready in distribution management system. These management systems will be in the future similar to the tools used in transmission control center.

The second challenge is the management of production and consumption patterns locally. Historically, networks

would have been reinforced to accept the full range of generation or consumption energy variations. But with smart technologies, opportunities are offered to act either on generation or consumption to alleviate some grid constraints. These techniques bring economical benefits for all stakeholders since they enable differed investments. But this implies that distribution networks are not only managed as they used to be but rather as distribution systems with enhanced observability, controllability and interactions with market stakeholders.

DSO should therefore act as System Operators to enable good command of the electricity flows for the sake of its own historical mission. But also, DSO should act as a market facilitator in the future markets dealing with flexibility and demand response for national purposes (balancing, capacity and energy markets) and in the 3 phases of these markets: certification, activation and evaluation, for the best economic rationale.

In this context, we will show how DSO's role is useful to all market's counter parts: customers, TSO, BRP, aggregators, and necessary to preserve the safety of the network for the sake of everyone's quality. This rationale is based on ERDF experience, acquired over the past years by working on the rules of the new French Capacity Market and evolution of balancing and spot market to allow the development of demand response.

THE DSO IS THE TECHNICAL CONTRACT HOLDER WITH THE CAPACITIES CONNECTED TO ITS NETWORK

In the certification process, the DSO gives a guarantee to the market that what is traded has consistency.
For instance:

- In case flexible generation is proposed, the DSO checks that the mean has the physical possibility to generate and the network to evacuate the capacity sold, at the period of time considered in the offer, according to its technical connection contract.

- In case Demand Response is proposed, coherence checking with the subscription of the customer and his history of consumption at different periods are made by the DSO.

In the evaluation and settlement process, the DSO, through his knowledge of internal and network connection schemes, can guarantee that what is measured and traded is really what corresponds to the benefit for the system.
Indeed, on sites, several points of sub-measures can co-exist. Knowledge of reduction of consumption or increase of production on one of them doesn't necessary mean there hasn't been a transfer towards another part of the electric installation of the site, cancelling the benefit for the system.

THE DSO IS IN CHARGE OF IDENTIFYING CUSTOMERS AND LINKING THEM WITH THEIR BRP

When dealing with DR on distribution networks, keeping track of Balancing Responsible Party requires a robust organization. Distribution network customers can change suppliers, and therefore BRP, every day. It is already in DSO's mission in most countries to keep that information up to date into their databases to allow precise settlement of electricity supply.

Both in the certification and settlement process, it is important to guarantee that one block of demand response is only sold once to the market. If no one has an exhaustive knowledge of contracts between sites and aggregators, this cannot be guaranteed. The DSO is the owner and guardian of unique identification of the sites on its perimeter.

In case of DR traded by an aggregator different from the supplier, the DSO should provide the necessary information to apply the rule set for the market to identify the BRP and calculate the energy really produced or consumed for the BRP's liability. Euros at stakes could be even bigger when DR blocks are expected to be traded on spot electricity market.

It is a normal extension of DSO's role to be a key contributor of that settlement for balancing, capacity and energy market.

THE DSO MANAGES METERING DATA

Demand Response, as opposed to electricity generation, is immaterial. Precise, well handled and trusted measures and associated methods are therefore of key importance in its trading.

Regarding the quality of the measures, DSO's meters fulfill metrological requirements. Future advanced meters systems will guarantee consistent measures, time stamping and synchronization – which is a prerequisite when data need to be aggregated. It is logical and economically rational that this advanced infrastructure be used by the markets.

Large DSOs like ERDF, with the incoming of smart meters, will develop skills in handling big amount of data. DSOs like ERDF already endorse responsibility for

the aggregation and extrapolation of complex data for the energy market settlement. They will naturally bring in that skills to contribute to the settlement of the new flexible, sophisticated products traded on the market. Indeed, the more actors in the markets are small and fluctuating, the more the settlement is complex and requires specific skills.

A Peak Load Shaving block is the quantity of energy that would have been consumed at that exact period of time if no action had been undertaken. Therefore its settlement is the result of indirect estimates, for instance it can be measured referring to a baseline.

Among all the possibilities to define that baseline, the control group comparison method is proved to be an efficient one [3]. A control group is a set of customers who are in the same geographic area and have the same consumption pattern as the ones that will be activated for Demand Response. The DSO is developing advanced metering systems which will in the end provide sophisticated metering devices to all customers, among which could be picked adequate control group members. Also, for the sake of its mission, the DSO has already paneled clients which enable the DSO to build profiles of consumption for allocation process in the energy market. It has the knowledge of all the customer of one zone, and is therefore the best suited to define that baseline.
Whatever the method chosen to define the baseline or settlement, the DSO has already acquired skills in modeling consumption patterns for its mission on allocation process and could therefore apply them for this new settlement process.

DSO SUPERVISES FLOWS ON ITS NETWORK AND IS RESPONSIBLE OF ITS SAFETY

As expressed in the introduction, the DSO who used to deal with predictable generation and consumption will run networks in the middle of highly intermittent flows. Local constraints (voltage fluctuations, high voltage or overload situations) will appear if the situation is not fully under control of the DSO.
DSO must make sure, at all time and at each point of the network, that difference between consumption and generation remain within construction margins, that dynamic capacities of the network are respected, and that synchronized end of load shaving does not lead to synchronized power peaks beyond the capacity of the network, power peaks possibly aggravated by snapback.
Also, the DSO must have the relevant information on users' behaviors in order to do the relevant short term and long term forecasting inherent in an efficient distribution system operator.

This means the DSO will need to be fully informed,

- in the certification phase and aggregation phase, to be able to identify future possible constraints and warn actors
- in the activation phase for proper real time management of its network
- in the settlement phase, to be able to model customers properly and plan future networks, and to fulfill its missions on settlement of flows for the energy market.

Information has to be precise and non-aggregated, enabling precise localization on the network components.

DSO IS AN INDEPENDENT PARTY WITH NON DISCRIMINATORY OBJECTIVES

All the facilitation mechanisms that have been described should be handled by a neutral party that has no financial interests in the energy market and that should handle commercial parties in a non-discriminatory way. Therefore, this mission should be a regulated activity supervised by national regulator. DSOs have in their very mission to guarantee a safe and secure access to the grid. In most countries, DSOs already handle metering activities and other energy settlement that have strong synergies with the described mechanisms. Moreover, DSO's activity is regulated and complies with neutrality and transparency obligations as well as obligations that protect commercial and private information of customers and market stakeholders.

ERDF IS CURRENTLY TESTING THESE PRINCIPLES IN A FIRST LOCAL CAPACITY MARKET – "EXPERIMENTATION BRETAGNE"

Brittany, in France, is an electric peninsula, which lacks local generation (which only fulfill 10% of local consumption) and transmission capacity. Each winter is a difficult period for the French TSO, RTE, in charge of balancing.
Therefore RTE has launched for winter 2012/2013 a call for tender, offering a fixed and variable revenue to book local capacity for balancing purposes. The objective was to secure economic conditions for local capacity (generation or load shaving) to emerge.
70 MW, from traditional or new aggregators, based on Demand Response and generation, have been secured on that call. All of them connected to ERDF's network.
In that experimentation, as specified in its rules, ERDF is testing all the principles stated in the previous paragraphs:

- administration of the aggregates and register of sites and BRPs by the DSO
- ex-ante technical information towards aggregators regarding distribution network

requirements
- real-time information of the DSO upon activation
- transmission by the DSO of metering data,
- test of control group baseline based on DSO's meters.
- Measurement of impacts of DR on networks

CONCLUSION

The deep evolution of the electric system that is forecasted, on generation as well as on demand side, and its tendency towards more decentralization, pushes the DSO towards a new evolved role of Local System Operator, to keep good command of electric flows.
By developing new tools and being at the crossroads of stakeholders on the distribution networks, the DSO secures the availability of all resources connected to the grid and plays a role of market facilitators for flexibilities offered to the national system and connected to its network.
DSOs could enable a new added value to aggregates that can be traded by actors on flexibility markets:

- In certification : in pre-qualification stage by checking the compatibility of the offer with its network, and by contributing to evaluate the service need and provision
- In the activation phase : by monitoring and supervising the consequences of the activation
- In the evaluation of balancing or capacity services and needs: by providing and processing data on both the service provided and the need for that service.

REFERENCES

[1] Source ERDF

[2] Bilan Prévisionnel RTE, Edition 2012

[3] Josh Bode, Michael Sullivan, Joseph H. Eto, 2012, "Measuring Short-term Air Conditioner Demand Reductions for Operations and Settlement", *ERNEST ORLANDO LAWRENCE, BERKELEY NATIONAL LABORATORY*