A solid foundation for smart energy futures

Harmonising EU aggregation models for effective demand-side response

Interim results of USEF's Aggregator Workstream

Energy flexibility and demand-side response (DSR) are essential for the European Union to meet its sustainable energy goals. Hence, a new role is emerging in the energy value chain: the flexibility aggregator. But different energy markets have different drivers and challenges. The industry- and continent-wide study currently being undertaken by the USEF Foundation's Aggregator Workstream aims to show how aggregation can be implemented effectively in different markets to deliver optimal flexibility for all.

The European Union is moving towards a more sustainable energy sector. The proportion of renewables is growing fast: The European Commission predicts it will rise from 25% today to 50% by 2030. At the same time, with increased electrification and the connectivity provided by the internet, the way we use energy is changing too. We are increasingly using electricity to power vehicles, heating / cooling systems, and many other aspects of our daily lives.

These trends will have major impacts on the power system. Patterns of peak demand and peak generation are going to shift, and will become increasingly out of step. So power systems will need more flexibility to balance supply and demand. And with traditional, fossil fuel-burning flexibility resources going offline for environmental imperatives, that flexibility will need to take new forms. On the other hand, companies and individuals can install their own renewable resources to shift from energy consumers to energy prosumers – drawing power from or feeding it to the grid depending on conditions. Prosumers have the potential to deliver that new form of flexibility the power system needs. The flexibility they offer individually may be small, but the overall power volume could be enough to keep the power system balanced.

Creating an accessible flexibility market

Now the questions are: how does the power sector take advantage of this new flexibility resource and how can prosumers benefit from the flexibility they can offer? It is widely accepted that the answer to these questions must be built on market-based factors such as incentives for prosumers who are willing to make their flexibility available.

One option is to expose prosumers to energy prices that reflect actual scarcity, allowing them to shift their energy demand to periods with low energy prices. Known as price-based or implicit demand response, this mechanism is already implemented in some countries for commercial and industrial segments. With a large-scale roll-out of smart metering, it can be applied for the residential sector as well.

However, both the energy balancing and supply adequacy markets require a second form: incentive-based or explicit demand response. Here prosumers can receive (financial) rewards for agreeing to respond to requests to adjust power generation / consumption. This is more suitable for energy balancing and supply adequacy as the flexibility is dispatchable and can be tailored to the markets' exact needs (size and timing).

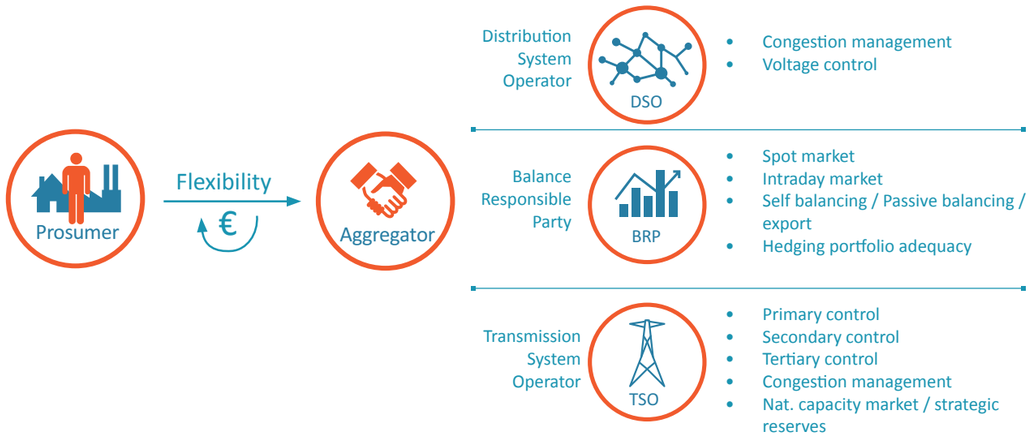
Incentive-based demand response leads to the emergence of a new type of player in the energy value chain: the aggregator. Operating between flexibility suppliers (in this case prosumers) and flexibility users – transmission system operators (TSOs), distribution system operators (DSOs) and balance responsible parties (BRPs) – the aggregator bundles many small flexibility resources into a useful flexibility volume (see figure).

This allows these smaller packets of flexibility to be traded, lowering the existing market-entry barrier for individual prosumers. As a result, incentive-based demand-side response becomes a possibility for all.

To see how aggregators open up new flexibility resources and make demand-side response possible, we can look at the example of Belgium. In the summer of 2014, Belgium was facing the likelihood of having insufficient generation capacity to meet demand during the upcoming winter due to essential maintenance at two nuclear power plants. The government prepared disconnection plans for end users as a last resort, but also asked the industry for help. This resulted in extra generation capacity by switching on emergency power facilities, and the possibility of reducing demand at industrial plants in return for financial incentives. Aggregators contracted the generation units and industrial plants, and offered the flexibility to the national TSO Elia. Today in Belgium, demand-response can also be part of primary, tertiary and interruptible contracts programmes.

An industry-wide view

Both regulators and industry bodies agree demand-side response will be a vital part of future sustainable energy systems and that aggregators are necessary to make this possible. Also it is generally accepted that regulation is required to secure aggregators' market access. But there is much debate about exactly how aggregation will work best in practice, and precisely what role regulation should play in defining aggregation implementation models and the wider flexibility market.



Ideally, prosumers should be free to offer their flexibility to any party they choose. However, how the market must be organised to realise this ideal while also meeting the needs of other stakeholders is not yet clear. Thanks to solid work by regulators and industry, though, good progress has been made in understanding the challenges of integrating demand-side response. And from these efforts it is becoming increasingly evident that no one solution for implementing flexibility aggregation will be suitable for all the different market situations that are likely to exist across Europe. In energy flexibility, one size does not fit all.

Looking at the bigger picture of demand-side response

To see why this is the case, we only need to look at the various challenges involved in integrating demand-side response.

Baselining

A baseline methodology is needed to quantify the performance of flexibility service providers and provide a basis for the transfer of energy. But who should be responsible for establishing this baseline methodology? And which parameters are used to ensure a sufficient level of accuracy and reproducibility?

Transfer of energy

Is an energy settlement between the aggregator's BRP and the supplier (and/or its BRP) needed? If so, how should this be organised? Which costs or avoided revenues should be compensated? Does the system need different policies for different types of customer?

Rebound effect

After a period in which flexibility has been activated, a rebound effect may occur. For instance, a reduction in energy consumption could lead to demand being shifted to a later time. Does this effect need to be neutralised towards the supplier or its BRP? If so, how?

Implicit or explicit?

In many cases, a flexibility resource may be subject to both price-based (implicit) and incentive-based (explicit) demand response. Can the impacts of the two forms be separated? Or does the combination need to be avoided?

Information exchange

For effective demand-side response, each player in the energy value chain will need information from others, for example to enable accurate forecasting or billing. However, some of this information may be commercially sensitive. Agreeing what information will be shared, when and at what aggregation level is thus critical.

Measurement and validation

How do you measure or calculate flexibility? Whose responsibility is it to do so? What is the role of sub-metering?

An engineering view

Clearly, then, the challenges involved in integrating demand-side response into a power system are many and varied. What's more, the relative importance of each of these challenges varies depending on the specific market, product, segment and resource type being considered. This explains why it is not feasible to expect that a single solution for aggregation will fit all likely market conditions acceptably. Insisting on such an approach would necessarily lead to compromise and dissatisfaction for some or all of the parties in the energy flexibility value chain.

So what should the flexibility market look like? This question has already been addressed by bodies such as the European Commission, CEER, EDSO, ENTSOE, EURELECTRIC, and the SEDC. While these works have begun to outline possible market and implementation models for aggregation, they have tended to take a high-level view of the issue.

Building on this firm grounding, the Universal Smart Energy Framework (USEF) Foundation is now addressing the same issue but from an engineering perspective, looking at the feasibility of implementation models. In its Aggregator Workstream, USEF has brought together a pan-European team of experts representing the various players and roles within the energy value chain in an effort to more concretely understand how the full complexity of demand-side response and energy flexibility impacts the implementation of aggregation.

Evaluating aggregation implementation models

The workstream has identified criteria that an aggregator implementation model should fulfil to be considered a good fit for a given market. As mentioned above, the model must allow prosumers a free choice of who they offer their flexibility to, while also being fair to all parties and minimising complexity. Moreover, within the specific conditions of the target market, the model should ensure transparency, verifiability and accountability yet protect (commercially) sensitive data. Finally, it must be market based, enabling the correct incentives to reward desirable behaviour and prevent gaming.

Aggregator implementation model classification

In addition, the workstream has presented a method for classifying aggregation implementation models. This classification is based on the following questions:

- Are the roles of the supplier and aggregator combined in a single market party?
- Does the aggregator also need to assign its own BRP?
- Does the aggregator need a contract with the supplier's BRP?
- For dual-BRP models: how is energy transferred between the aggregator's BRP and the supplier's BRP?

USEF has identified a complete set of possible aggregation implementation models beyond those identified in previous works. In total, we have defined seven implementation models. Together these models provide a common starting point that will streamline cross-border trading of flexibility products and the creation of a single European market for demand-side participation.

Helping Europe deliver effective demand-side response

Different aggregator implementation models are currently emerging in different countries. Yet for a truly transparent and integrated flexibility market, we need more harmonisation of roles and processes.

To support that harmonisation, the USEF Aggregator Workstream will deliver a comprehensive set of recommendations and considerations that specify how to integrate demand-side flexibility in all relevant markets and products. The final results of this work are due to be published in Q4 2016.

The Aggregator Workstream consists of Ulrik Stougaard Kiil (Energinet), Klaas Hommes (Tennet), Poul Brath (Dong Energy), Paul de Wit (Alliander), Valentijn Demeyer (Engie), Claus Fest (RWE), Peter Schell (Restore), Andreas Flamm (EnerNOC), Hans de Heer (USEF) and Marten van der Laan (USEF).

More details on flexibility markets, the role of aggregation and possible implementation models can be found at www.usef.energy.

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