DNV·GL

Short study on

Demand Response Activation by Independent Aggregators As Proposed in the Draft Electricity Directive

On behalf of EURELECTRIC

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1 INTRODUCTION

Importance of Demand Response as Flexibility Source

Demand response (DR) is widely considered to be a valuable and versatile source of flexibility. It can contribute to a reliable power system and price stability on power markets, both being increasingly characterised by intermittent renewable energy generation.

For instance, activated as load shedding or load increase for the provision of balancing energy, it may help the system operator to balance the overall power system by reducing the imbalance between generation and demand of electricity in real-time. DR may also help distribution network operators (DNO) to avoid or mitigate network congestion and, in the long term, reduce the need for network extension.

Load shedding and load shifting may displace more expensive generation technologies and may contribute to more stable market prices. At wholesale markets, DR may also provide flexibility to better align demand and supply; Electricity suppliers are enabled to adjust their supply to the demand of their customers and eliminate foreseeable imbalances in their supply portfolio in the short-run (i.e. within a day).

DR may gain revenues at high market prices through peak shaving. Flexible consumers can use their ability to shift demand from hours with high prices to hours with smaller prices.

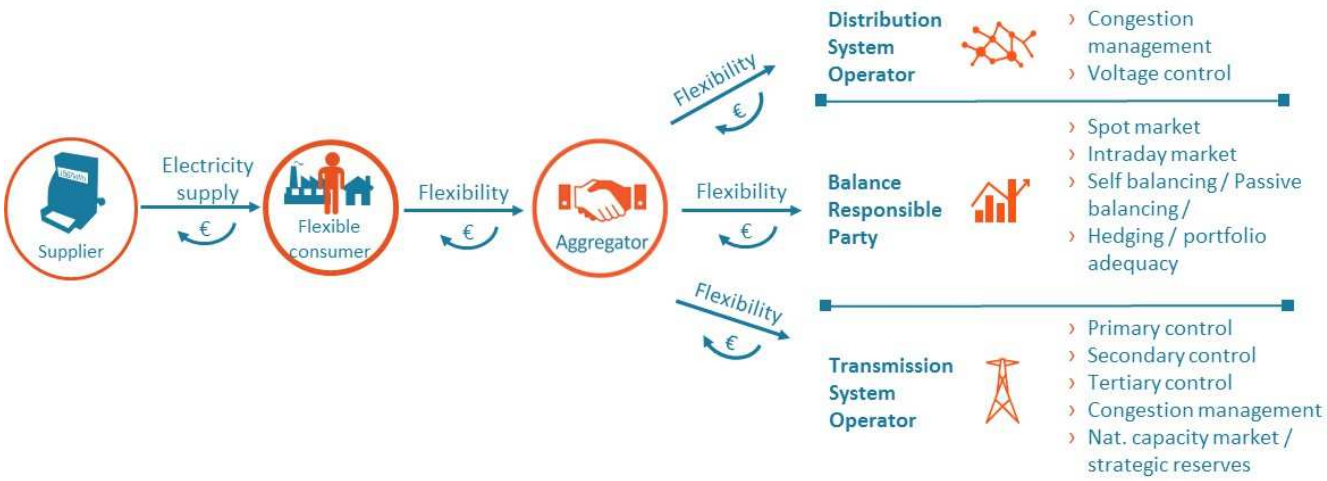


Figure 1: Overview of Flexibility Services Provided from DR via an Aggregator

Source: DNV GL, based on USEF

Explicit DR requires the possibility to access the different wholesale market segments and a facilitator to be able to offer flexibility where needed. This role is labelled "aggregator" and can be taken by the existing supplier or a third independent party.

As of today, the conditions for DR are quite heterogenous across EU member countries. First, the regulatory framework is not suitable everywhere for DR to flourish. Secondly, in current EU markets explicit DR applications are rather underdeveloped, as a recent study shows.[1]

[1] "Demand Response status in EU Member States", Paolo Bertoldi et al. (JRC), 2016

To improve the prospects for DR, unfold its full potential and be able to fully exploit its benefits, a suitable regulatory framework is needed. It should aim to enable the role of an independent DR service provider and facilitate the efficient activation of DR and the creation of a level-playing field across EU member states.

The EU Proposal on DR Aggregation

To enable the power market to make better use of the existing potential of explicit DR[2], the EU Commission proposes a new piece of regulation in a draft Directive.[3] In its latest proposal, the EU Commission introduces the concept of aggregators and independent aggregators. An aggregator combines multiple consumer loads or generated electricity for sale in the wholesale power market or other markets of the electricity system, or alternatively for purchase or auction in any organised energy market. An independent aggregator[4] is not affiliated to the supplier of the relevant consumer or the supplier's BRP. Based on that, promotional provisions for DR aggregation in the draft Electricity Directive include:

- National regulatory regimes shall encourage the non-discriminative market participation of DR, without the need for aggregators to have the consent of other market participants to enter the market (Art. 17.3a).
- Aggregators shall not be required to pay compensation to suppliers or generators (Art. 17.3d).
- National regulation may make aggregators only liable to compensation payments to balance responsible parties in situations where imbalances are induced on market participants that result in a financial cost. (Art. 17.4).

Background to the EU Proposal: The Imbalance Issue and the Bulk Energy Issue

Articles 17.3 and 17.4 of the EU proposal are related to the '**imbalance' issue** and the '**bulk energy' issue**, respectively.

To explain both issues, we assume a flexible electricity consumer has an electricity supply contract with a supplier. It also has DR flexibility that it intends to offer to the market.

For each point in time, the supplier acquires the amount of energy the consumer is expected to consume and informs the TSO about the consumer's projected consumption on a 15-minute' to 60-minute basis[5] for the next day or hours (called "scheduled demand" in Figure 2). Moreover, the supplier takes responsibility for imbalances between the flexible consumer's forecasted and actual consumption that may occur in real-time[6].

Apart from the supply contract, we assume the flexible consumer holds a DR contract with an independent aggregator A (i.e. an aggregator not identical to the supplier). The contract gives the

[2] One may distinguish between explicit and implicit demand response. By explicit DR we refer to DR that is actively sold into one of the markets of the power system, as distinct from DR that reacts to wholesale market power prices. This report is about explicit demand response only.

[3] We analysed the updated Proposal for A Directive Of The European Parliament And Of The Council on common rules for the internal market in electricity; EU Commission, 2016/0380 (COD), 23.2.2017

[4] Some documents use the term "third party aggregator" instead.

[5] Depending on the resolution of the power market rules of country in question.

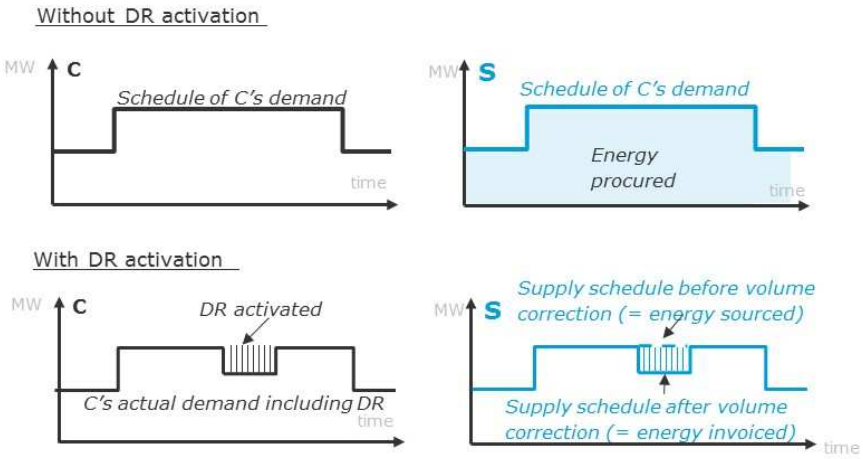
[6] A different model is used in France, where the TSO targets a balance between injections (= generation + imports + purchases) and withdrawals (= consumption + exports + sales).

aggregator the right to offer DR flexibility to the market to the extent agreed with the flexible consumer, e.g. as balancing power to the TSO, in the wholesale market (e.g. intraday) or to the DNO. The aggregator is entitled to activate the DR flexibility when required or opportune (and technically capable of doing so).

If at any point in time (either close-to-real time or in real-time) the aggregator activates DR, the flexible consumer's electricity demand is likely to deviate from the forecasted consumption pattern for that point in time. This difference in volume is settled financially between the TSO and the so-called balancing responsible party (BRP), to which the supplier adheres. A balancing responsible party is a market role in most power systems (though not all[7]) that is specifically defined to settle differences between the scheduled and actual values of consumption, generation and trade[8]. All market participants must adhere to a balancing responsible party.

The imbalance provoked in the supplier's portfolio will first appear in the balance account of the BRP to which the supplier adheres. It may be expected that the result of the financial settlement between the TSO and the supplier's BRP will then be settled between the supplier and the supplier's BRP. The supplier will finally bear the full risk of any imbalances in its supply portfolio.

The ***difference between the scheduled and the actual consumption*** in the supplier's supply portfolio at a specific hour is hereafter called the **'imbalance issue'**. This issue arises in particular when DR is activated by an independent aggregator and there is no volume correction or energy transfer (see below for further explanations).



S – supplier; C – flexible consumer

Figure 2: Overview of the Operation and Impact of Demand Response Activation

Source: DNV GL

Whenever DR is activated by an independent DR aggregator, the flexible consumer's ***actual consumption*** also deviates from the ***amount of energy procured by the supplier*** for this consumer in a specific period (e.g. 1 hour), with the supplier not knowing that DR could be activated. For instance, if the flexible consumer provides DR in the form of load shedding (probably the most common DR application), the actual consumption falls short of the amount of energy procured by the supplier (cf.

[7] see footnote 5

[8] System imbalances -resulting from the sum of BRP imbalances- are physically mitigated by the TSO that activates balancing reserves. The cost are transferred to responsible BRPs; however, parties that supplied more energy than foreseen can be partially compensated.

Figure 2). In the absence of further arrangements, the supplier may not invoice this difference and recover the full electricity procurement cost. This is labelled the **bulk energy issue**.

Of course, DR may also be activated to provide flexibility to the system in the form of load increase. The supplier would then face an increase in consumption from the flexible consumer and the supplier would be able to invoice a higher amount than without DR. In this case, the supplier would not face the bulk energy issue. However, load increase alone[9] is not the aggregator's main priority, unless the price for the energy additionally consumed during load increase is negative and the aggregator would make monetary gains.

It should be noted that both the imbalance and the bulk energy issue refer to the same point in time and amount of energy. Depending on the sourcing cost and the imbalance settlement price, the combination of the two issues provides for complex and undesired incentives for the supplier. This is one of the reasons why both issues should be solved.

In summary, under the current draft of the EU, the independent aggregator is likely to have a considerable impact on the supplier (and its BRP) with regard the imbalance issue and the bulk energy issue, when seeking commercial benefits from the activation of DR. The aggregator's actions may, in economic terms, cause external costs to the supplier and its BRP.

Both issues raise the question of compensation. In fact, the EU proposal considers the implementation of some compensation on behalf of the aggregator for the imbalance costs induced by its activities. But it excludes the option of the aggregator paying for the sourcing of the energy that it resells to other market participants.

[9] without load shedding either before or afterwards

2 ASSESSMENT OF THE EU PROPOSAL

Against this background, DNV GL evaluates the EU Commission's draft proposal for DR activation by independent aggregators. In this analysis, we consider different aspects that are usually considered key for the functioning of the power system:

- Consistency with electricity market principles
- Economic efficiency
- Distributional and competition effects in the retail market

Whilst DNV GL appreciates the introduction of the aggregator role by the EU proposal, we have concerns about the implications of Article 17.3 and Article 17.4. In our view, the EU proposal does not adequately address the the imbalance and the bulk energy issue. It also does not sufficiently compensate the disadvantages induced on suppliers that are affected by DR activation from independent aggregators. If the EU proposal remains as it is, this will conflict with fundamental power system and market principles as well as the targets of economic efficiency and upholding a level-playing field in the retail market.

Balancing Responsibility and the Imbalance Issue

Balancing responsibility is a fundamental pillar of European power markets, enshrined in legislation across the EU. It is implemented by the concept of balancing responsible parties (BRP). BRPs are financially responsible for keeping their own position (sum of their injections[10], withdrawals[11] and trades) balanced over a given timeframe.[12] A short or long energy position in real-time that persists until the end of that balancing period corresponds to a negative or positive imbalance, respectively. Imbalances[13] are financially settled between the BRP and the central settlement agent, often the TSO. No market participant shall remain outside the balancing mechanism and each of them must be associated to a BRP.

The draft Internal Market Regulation (Art. 4.1)[14] clearly states that all market participants must take financial responsibility for the imbalances they cause in the system. However, in Art. 17.4, compensation payments owing to aggregators' imbalances are phrased as an exception rather than a general rule. This leaves scope for interpretation on whether aggregators should be subject to balancing responsibility at all and, if so, to which extent.

Balancing Responsibility of the Aggregator

First, Article 17 is not clear about whether independent aggregators have balancing responsibility for their own imbalances.

In the absence of balancing responsibility of the aggregator, it would not be subject to imbalance settlements. The corresponding costs and risks would be spread to other BRPs or via system service charges to other market participants, like consumers. For instance, if the aggregator fails to activate the required amount of DR (power and duration) for the provision of balancing power, the TSO would not be

[10] E.g. generation

[11] E.g. consumption

[12] Known as Imbalance Settlement Period (ISP), e.g. 15-minute, 30-minute or hourly basis (depending on the power system)

[13] Often based on the difference between schedules and actual values (consumption, generation, trades).

[14] Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the internal market for electricity, EUROPEAN COMMISSION, Brussels, 23.2.2017, 2016/0379 (COD),

able to attribute the mismatch between the flexibility that the aggregator is contracted for and the flexibility delivered in real-time.

We therefore conclude that the aggregator and its BRP shall not be exempt from their balancing responsibility. Not allocating balancing responsibility to independent aggregators would violate EU regulations, constitute preferential treatment, undermine the incentives to market participants for keeping always their portfolio in balance and put system stability at risk.

Need for Clear Responsibility to Avoid Imbalance Issue

Assuming an independent aggregator is responsible for its own imbalance, it is also unclear to which exceptional situations Art 17.4 is referring and whether the aggregator might be obliged to take responsibility for the imbalance issue.

Nonetheless, we would like to point out that common practice can be applied to DR to largely remove the need for financial compensation to the supplier for the imbalance issue.[15] The imbalance issue may be solved either through a transfer of energy between the supplier and the aggregator (or its BRPs) before DR is activated or through ex-post correction of imbalance volumes, i.e. after DR activation. Figure 3 below illustrates how an energy transfer[16] works. This mechanism leads to a transfer of the (responsibility for) actual or potential imbalances from the supplier to the aggregator.[17]

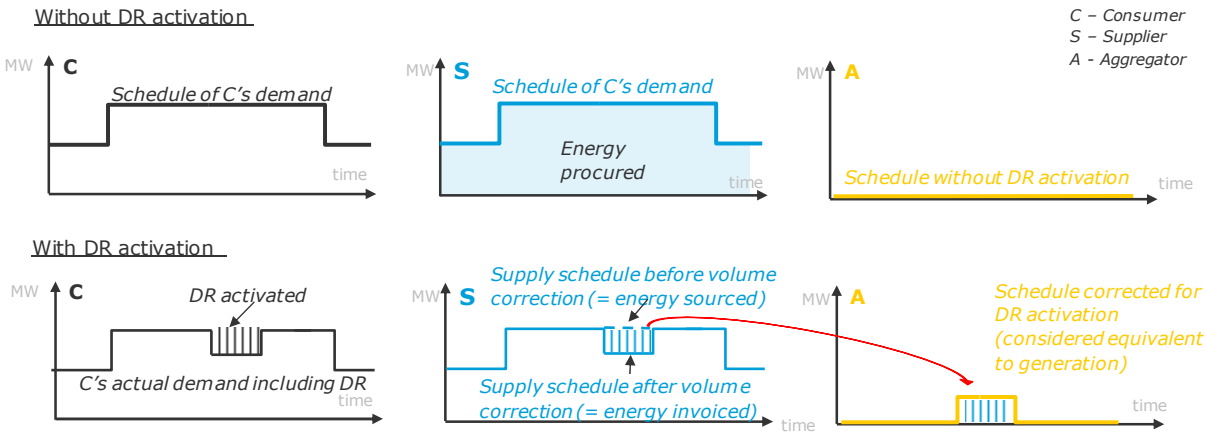


Figure 3: Illustration of a Shift of Imbalances / Imbalance Responsibility from the Supplier's BRP to the Aggregator's BRP

Source: DNV GL

While the specific mechanism should be tailored to whether DR is activated for trades on the wholesale market (e.g. ID) or for balancing energy,[18,19] energy transfer (implemented by the system operator) is an efficient way of eliminating the imbalance issue (for the supplier). It would be a suitable mechanism to allocate the balancing responsibility for the energy volumes involved in DR activation to the aggregator.

[15] For instance, in some countries it is allowed that market participants that are associated with different balancing responsible parties may transfer imbalances determined by the TSO for each of them between each other. They may want to exchange opposite imbalances to reduce the imbalance amount they are liable for.

[16] Often called also ‚volume correction'.

[18] When delivering balancing energy, one may further differentiate between delivery by schedule adjustment or not.

[19] Volumes refer to the consumption of the flexible consumer that is or will be altered by DR activation. It means transferring the share of saved or additional consumption that is attributable to DR from the supplier to the aggregator.

In fact, it is difficult to imagine how the imbalance issue could be solved and BRPs can comply with their balancing responsibility without energy transfer between the supplier and the aggregator (or the BRPs they adhere to) during DR activation.

We therefore conclude that the EU proposal should tackle the imbalance issue clearly and point to volume correction as an existing remedial instrument or any other appropriate alternative.

Nonetheless, we note that despite energy transfer the imbalance issue may persist beyond the activation of DR by the independent aggregator. This happens with rebound consumers, i.e. consumers who, due to the energy requirements in their processes, must offset the DR activated by additional / less consumption afterwards. If the aggregator has no active role in the rebound and the energy transfer between the supplier and the aggregator is applied to the initial DR activation by the aggregator only,[20] the imbalance issue would hit the supplier in the rebound period.

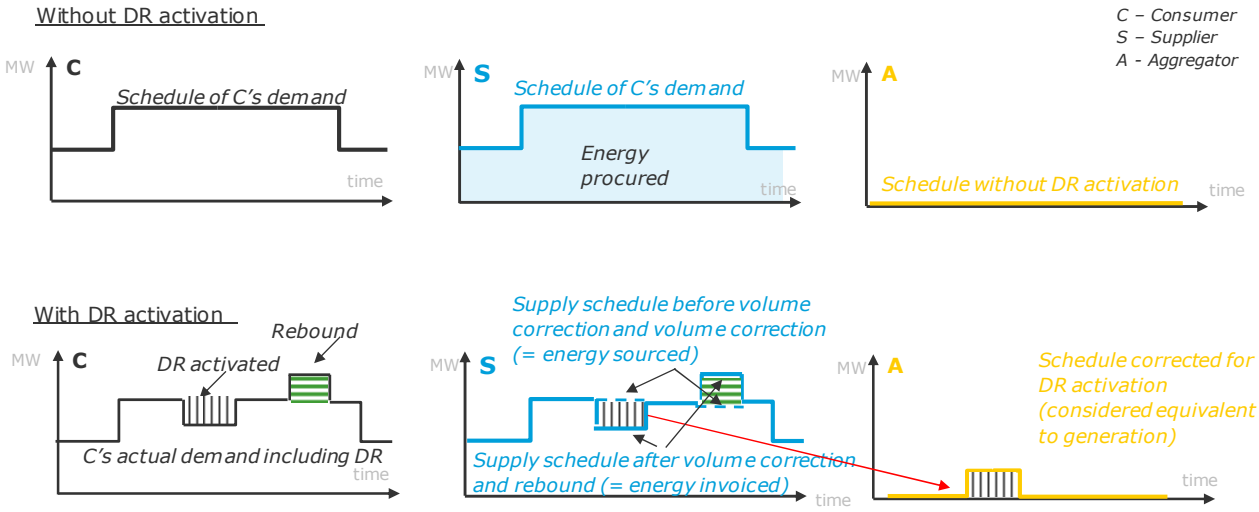


Figure 4: Operation and impact of DR activation with rebound and volume correction

Source: DNV GL

Bulk Energy Issue

Provided energy transfer was applied (both for the initial DR activation and the rebound), there may still be a negative impact on the supplier and the system, if there is no (financial) compensation to the supplier for the bulk energy issue. Solving the imbalance issue[21] does not resolve the bulk energy issue or reveals it even more. This is because with DR activation for load shedding there will be a discrepancy between the energy sourced by the supplier and the energy it may invoice to the flexible consumer.

The persistence of the bulk energy issue without compensation results is detrimental both from the perspective of economic efficiency, general market principles and retail market functioning, as the following observations show.

[20] If there is no ex ante energy or ex post imbalance transfer, the double mismatch between the energy produced by supplier and consumed by the flexible consumer hits the supplier in two different points in time. They are settled via imbalance settlement by two different prices. As imbalance prices usually vary during the day, the difference in imbalance prices is a risk to the supplier.

Aggregator Re-Routes Energy to the Market without Compensation to the Supplier

From a conceptual point of view, the supplier procures all electricity for supply to its customers before it is delivered, often the electricity is sourced far in advance. With the procurement contract the supplier is entitled to a part of the electricity that will be generated at a specific time in the future when its customers consume electricity.

Contrary to that, the DR aggregator does not conclude the same or similar procurement contract.

Without DR

With DR activated by an independent aggregator for load shedding

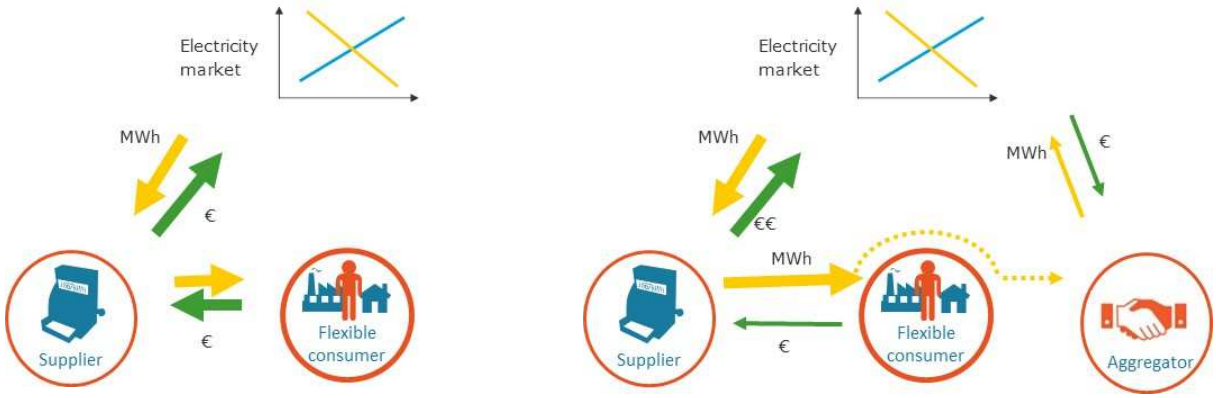


Figure 5: Illustration of Re-Routing by the Aggregator of Energy Procured by the Supplier without Compensation by the Aggregator

Source: DNV GL

With load shedding, the independent aggregator takes possession of energy that was procured by the supplier of the flexible consumer. Without paying for it, the aggregator re-sells the electricity sourced by the supplier on its own behalf and re-routes the energy back to the power market. This corresponds to a form of electricity short-sale without the supplier's consent, providing liquidity and flexibility to the intraday and balancing market. The aggregator generates revenues at the cost of the supplier, thus violating of the general market principle that energy sold needs to be bought (or compensated).

And irrespective of the DR's benefits to the market,[22] there is no reason why any market participant should not pay for the sourcing of energy and the energy taken from another market participant, in this case the supplier, without the latter's consent.

Risk of Inefficient DR Activation by Independent Aggregators

Without sufficient compensation for the energy that is procured by the supplier but that may not be billed in the case of load shedding, the aggregator becomes a free rider of the system. Benefits of DR activation accrue exclusively for the aggregator, while the costs for uncompensated energy are incurred by the supplier.

Consequently, unfavourable incentives for DR activation by an independent aggregator may arise and may lead to economically inefficient activation of DR from an overall system perspective. This is when the revenues generated by the aggregator from the activation of DR are smaller than the costs induced

[22] see below argumentation on market efficiency expectation

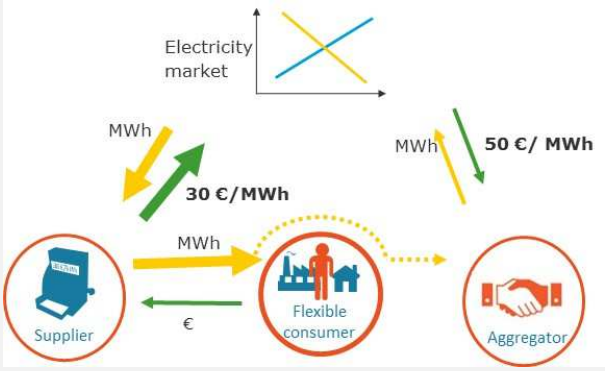
on the supplier. This may occur when the price at which DR is activated, e.g. for balancing energy provision or for energy trade on the intraday wholesale (ID) market, is lower than the supplier's decline in revenues from bulk energy sales (see box below).[23]

Direct compensation to the supplier, either by the aggregator or alternatively by the flexible consumer, would reduce the DR potential to a degree that is economically feasible and beneficial from an overall system perspective.

Efficient and inefficient DR activation illustrated

The following graph illustrates two situations for DR activations by the aggregator that may turn out to be efficient (left) and inefficient (right) from the power system's perspective. DR activation will be inefficient when the price at which DR is activated and energy re-routed to the market, e.g. for balancing energy provision or for energy trades on the intraday wholesale (ID) market, is lower than the supplier's decline in revenues from bulk energy sales, which roughly corresponds to the price at which the supplier procured the energy[24]. If the aggregator is freed from any compensation for the bulk energy issue, inefficient activation of DR is a considerable risk.

Efficient activation of DR



Inefficient activation of DR

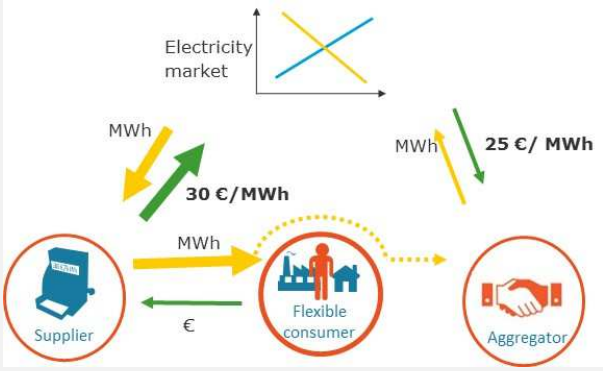


Figure 6: Illustration of the Economic Efficiency and Inefficiency of DR Depending on the Price at which DR is Activated and Energy is Procured by the Supplier

Source: DNV GL

Supplier Compensation Ensures Long-Term Efficiency

It is sometimes argued that compensation of the disadvantages that suppliers incur in the short-run is not needed.[25] According to those who say so the overall benefits of DR in the power system will, in the long-run, outweigh the potential disadvantages for individual market participants. DR is expected to lower wholesale market prices due to a displacement of more expensive generation technologies and lead to a decline in sourcing costs for suppliers.[26] Suppliers that are detrimentally affected by

[23] We ignore the difference between the tariff at which the consumer is supplied with energy and the price for the procurement of that energy the supplier pays.

[24] In terms of economics: whenever the external cost of DR activation caused by the aggregator exceed the actual value of his sales, a free-rider inefficiency is caused.

[25] See for instance, Phil Baker (The Regulatory Assistance Project, RAP), "Benefiting Customers While Compensating Suppliers: Getting Supplier Compensation Right", October 2016

[26] According to the EU Commission's estimate its proposal for incorporating DR into the energy market would result in savings to the extent of ca. € 5.6bn/a for a decline in back up and network transmission capacity required and fuel costs, noting that, at present, the DR potential is exploited to the extent of 20% only.

independent aggregators in the short-run would, in the long-run, be better off i.e. DR's long-term benefits will ultimately outweigh the negative short-term impacts.

We have reservations about this idea. DR will have a positive impact on the market and market prices. However, it is hard to estimate to what extent DR can drive down wholesale prices in order that its benefits for all market participants outweigh its costs (for some suppliers) and long-term economic efficiency is ensured. The willingness and the potential to provide DR flexibility to the electricity market remain to be seen. Moreover, only part of the DR will be sold to the spot market, and a considerable other part will be sold to balancing or other markets.[27]

Even if wholesale market buyers benefited noticeably from lower wholesale market prices, suppliers affected by the negative spill-over effects from DR will probably not be sufficiently compensated in the long-run, as the benefits of DR will spread over many market participants. . Consequently, we expect a distortion of the level-playing field in the supplier market, with persistent negative effects on efficiency and consumer prices above the competitive level.

Distorted Level-Playing Field of Supplier Business

Without proper compensation of the bulk energy in the short-run, DR offering and activation by independent aggregators will distort the level playing field on the retail market. Suppliers affected by DR may have higher sourcing costs when pricing-in the flexible consumer's DR potential and demand volatility while their revenues will decline.

In the absence of a direct and sufficient compensation for the bulk energy induced on the supplier, it may want to allocate the cost from independent DR activation to the flexible consumer adapting the supply contract and tariff. Alternatively, the supplier may spread the cost among all its other customers. This will render the supplier less competitive compared to retailers that are not or less affected by independent DR activation.

Small retailers, in particular, have fewer means to avoid the negative impact of DR activation by independent aggregators. And, they may often not become aggregators themselves and combine the role of retailer and aggregator. Becoming a competitive DR aggregator may require high investments to set up new processes and IT, and build up expertise. Retailers would also have significant operational expenses to keep their work force active, at best, 24 hours a day and 7 days a week. This is hardly feasible for small retailers and therefore favours large suppliers.

Will small and large suppliers be equivalently affected by non-compensation of the spill-over effects from DR?

It may be expected that independent DR activation without any or insufficient compensation poses a higher risk to small suppliers as opposed to large ones. Small suppliers usually have no direct access to the wholesale market and therefore have higher electricity procurement costs as they use intermediaries, such as brokers, traders and large suppliers for sourcing. Their supply portfolio also tends to be smaller and less balanced. Therefore, individual, large consumers that provide DR to the market may have a considerable impact on the supplier's economic situation. Hence, the bulk energy issue is more pronounced for them while disposing of limited means for hedging.

In turn, larger suppliers may procure electricity at a lower cost. Due to economies of scale and

[27] This is a significant difference w.r.t. the U.S.: here, all power market trade is executed via a power pool, and it is guaranteed that DR benefits all buyers in the wholesale market.

higher demand they may achieve better procurement conditions with their intermediaries, or have direct market access. Moreover, they can better hedge imbalance risks as they have a larger and more heterogenous portfolio (incl. trading, generation), allowing them to make better use of the portfolio effect. Finally, they may better mitigate the economic impact of large DR sources. Their customers will, to a lesser extent, notice an increase in their supply tariff if the supplier opts to allocate to them the costs and risks associated with DR activation.

When affected by a repeated drop in sales, profit margins and competitiveness the supplier may be forced to leave the retail business or give up some consumer segments in the long-run. Market distortions, such as the unequal impact of aggregators on suppliers, may lead to market consolidation in the long-run and thus to a less competitive environment.

This may be followed by detrimental impacts on competition and market concentration in the retail business, thus jeopardising the EU policy's ambition to achieve competitive retail markets and lower energy prices for end consumers. Thus, negative distributional effects may imply further efficiency problems.

With compensation to suppliers the efficiency gains of DR will also most likely benefit consumers directly. Efficient DR activation will prevail and as compensation does not affect price formation, potential price reductions in wholesale markets can take effect. So, those member states that introduce some form of compensation may have more efficient electricity markets.

Numerical example of the distortion of supplier business by aggregators

The table below illustrates the potential damage to suppliers when DR is activated as load shedding. The impact is estimated for different market prices. It is assumed DR was activated by an independent aggregator and sold on the intraday markets of France and Germany in 2015 or 2016[28].

The assumption has also been taken that a flexible consumer keeps a flexibility of 1 MW available that could be activated continuously but not for more than 2 consecutive hours on any one day. DR activation is always considered provided the average wholesale market price during 2 consecutive hours is equal or above a certain price. Among all relevant situations during one day we assume DR will be activated in that 2-hour period that provides for the highest revenues to the aggregator. We value the energy procured by the supplier but not billed to the flexible consumer at the D-1 price for that hour. Alternatively, one may argue that the supplier sources the energy and supplies it to the consumer at a (flat) price similar to the base load price. [29] Therefore, we also calculate the damage to the supplier based on the annual base load price for electricity.[30]

In 2015 and 2016, DR would have been activated to the extent of 228 to 590 MWh provided DR had been activated at an ID market price of 40 €/MWh or more, depending on the market segment considered. This would have led to a loss in revenues to the supplier in the range of 7,000 – 30,000 €/year, if the energy not invoiced to the consumer is valued at the hourly D-1 price. If the energy is

[28] It is important to note that an analysis based on actual wholesale market data will underestimate the market distortion by independent aggregators under a non-compensation regime. This is not only due to the limited scope of DR in the market today, but also due to the fact that future wholesale market prices can be expected to display higher levels of variation.

[29] This is an assumption. Indeed the actual sourcing costs vary from one supplier to another and this is commercially sensitive data. Sourcing costs also depend on customers' segments and consumption profiles.

[30] Disregards the procurement cost (trading fees, risk premium) and profit margin

valued at the annual base load price, the loss to the supplier would have been 7,000-18,000 € / year.

If one assumes that the 1 MW of flexibility is provided by a base load consumer and is available for 8,760 hours a year and the revenue loss would be allocated to the flexible consumer, the price for the supply of 8760 MWh would increase by 0.8-3.5 €/MWh or 3%-9%. If, however, the flexible consumer had a constant load of 10 MW, the tariff increase for the supplier would be reduced by a factor of 10.

With a higher market price, e.g. 55 €/MWh, the impact on the supplier and the flexible consumer decreases correspondingly because there would have been less DR activations.

Without being liable to pay compensation for the bulk energy issue, the aggregator may also consider activating DR at rather low prices, e.g. 25 €/MWh. This increases both the losses to the supplier and the risk of inefficient DR activation.

Table 1: Assessment of the Potential Economic Impact of DR Activation by Independent Aggregators in the Intraday Market in Germany and France in 2015 and 2016.

	Germany				France
year	2015	2016	2015	2016	2015
market segment	1 h	1 h	1/4 h	1/4 h	1 h
Average market price (€/MWh)					
base	31.20	28.20	33.09	29.74	38.91
peak	34.25	30.64	35.15	31.38	42.92
Minimum ID Market Price for DR Activation: 40€/MWh					
Activation of DR					
number of activations	254	164	227	114	295
number of days	70%	45%	62%	31%	81%
energy activated by DR (MWh)	508	328	454	228	590
Loss to supplier					
total (€/year) [a)]	24,507	15,771	13,606	7,207	30,859
-relative to 1 MW base load demand (€/MWh)	2.8	1.8	1.6	0.8	3.5
-relative to supply cost of 1 MW base load price	9%	6%	5%	3%	9%
total (€/year) [b)]	15,847	10,232	14,163	7,113	18,405
-relative to 1 MW base load demand (€/MWh)	1.81	1.17	1.62	0.81	2.10
-relative to supply cost of 1 MW base load price	6%	4%	5%	3%	5%
Minimum ID Market Price for DR Activation: 55€/MWh					
Activation of DR					
number of activations	77	43	66	24	142
number of days	21%	12%	18%	7%	39%
energy activated by DR (MWh)	154	86	132	48	284
Loss to Supplier					
total (€/year) [a)]	8,666	5,313	3,870	1,490	16,522
-relative to 1 MW base load demand (€/MWh)	1.0	0.6	0.4	0.2	1.9
-relative to supply cost of 1 MW base load price	3%	2%	1%	1%	5%
total (€/year) [b)]	4,804	2,683	4,118	1,497	8,859
-relative to 1 MW base load demand (€/MWh)	0.55	0.31	0.47	0.17	1.01
-relative to supply cost of 1 MW base load price	2%	1%	1%	1%	3%

a) Sourced energy valued at the corresponding D-1 market price for that hour; b) energy valued at the annual base load price.

Source: DNV GL

Apparently, the magnitude of the loss of revenues to the supplier and the impact on its customers varies with several parameters. For small suppliers the revenue decline may be considerable compared to its portfolio size. And so will the supply price rise substantially, if the supplier chooses to allocate

these costs to the flexible consumer or all consumers in its portfolio. If the relative size of the flexible consumer's DR flexibility (in MW and available hours per day) to its size (total load and consumption) is large, the increase in its supply tariff may be more significant compared to a big consumer.

The empirical analysis for the intraday market in 2015 and 2016 suggests that the scope for DR activation and the risk to the supplier would have been limited. Nonetheless, commercial losses to suppliers should be considered a relevant issue for the following reasons. Balancing markets may provide for higher incentives for DR activation and a more pronounced risk to the supplier. In addition, profit margins in the retail market may be rather small and may be fully offset by the losses made by the supplier due to independent DR activation. And, the impact of DR may be more significant in the future than today, as more volatile prices and higher peak prices might increase the activation frequency of DR.

3 SUMMARY AND RECOMMENDATIONS

Conclusions on the EU Draft Proposal

Our study finds that sound market design for the role of the independent aggregator requires addressing both the bulk energy and the imbalance issue and a dedicated solution.

The potential non-compensation for the bulk energy by the aggregator and the imbalance risks induced on others, as proposed by the EU, are problematic regarding several aspects. It may violate fundamental principles of the power market and system and may be contradictory to the targets of economic efficiency of wholesale markets and well-functioning retail markets.

We recommend establishing the responsibility of aggregators for the imbalances produced. This means, at the least, balancing responsibility towards its BRP (and eventually towards the TSO).

Furthermore, the imbalance issue from the supplier's perspective should be addressed. In practice, some form of shift of imbalance responsibility or energy transfer is known to many power markets. It means shifting, from the supplier to the aggregator, that part of consumption of the flexible consumer that is associated with DR and that results for the supplier in an imbalance between the assumed and the actual consumption by the flexible consumer. This may also be applied to independent DR activation. It would considerably reduce the imbalance issue for the supplier and allocate the balancing responsibility for the energy volumes involved in DR activation to the aggregator. However, compensation should take the rebound effect into account, e.g. by extending energy transfer/ volume correction to rebound as well.

In addition, the non-compensation to the supplier by the aggregator for the bulk energy, as proposed by the EU proposal, is inadequate as the aggregator takes possession of energy that is sourced by the supplier. Moreover, without compensation to the supplier situations may occur where the costs of DR activation induced on the supplier exceed the economic benefit from it. This is economically inefficient. Therefore, the bulk energy issue should be recognised and rules to compensate suppliers should be set up.

Moreover, DR activation will probably not lead to a significant decline of wholesale market prices in the long-run so that sourcing costs of suppliers would decrease and the disadvantages due to independent DR activation would be offset. Even if such an optimistic assumption would materialise, DR would distort the level playing field among retailers. Those suppliers that are affected by independent DR activation will remain with a strategic disadvantage over their competitors, which would be less affected by DR, if short-term spill-over effects from DR activation are not directly compensated for. They will lose competitiveness and may be forced to retire from some retail market segments. This may, in the end, negatively impact economic efficiency in the overall system.

All in all, the business model of independent DR aggregators should not be implemented at the cost of economic efficiency for the system. DR activation by independent aggregators should also be neutral for the supplier.

Further Comments on Alternative Approaches for Compensation of the Bulk Energy Issue

In the following we outline alternative approaches to compensate the supplier for the bulk energy issue, assuming the imbalance issue is tackled by energy transfer.

Full compensation may be provided by

- the aggregator,
- the flexible consumer, or
- socialisation of costs.

These approaches for compensation rest on different mechanisms that have been proposed or adopted in different markets (see also Annex) and that promise improvements compared to the EU's proposal.[31] In turn, the EU proposal allows, in principle, for non-compensation, the compensation by the flexible consumer or socialization.

These approaches perform quite differently with regards to the criteria that we used to analyse the EU proposal, i.e. economic efficiency, compatibility with power market /system principles and distributional effects on retailers. There are clear advantages of the compensation of the bulk energy issue either by the aggregator or the flexible consumer over both the non-compensation as proposed by the EU Commission or the socialization of the costs. This is illustrated in the figure below.

We recommend the regulation should be amended and explicitly allow also for the model of direct compensation by the aggregator. In addition, the bulk energy should be resolved by full compensation to the supplier by the aggregator or the flexible consumer, or should be shared among them. Non-compensation to the supplier and socialization should be omitted.

Economic efficiency	–	+	(+)	–
Sourcing costs paid	–	+	(+)	+/–
Distributional effect on retailers	–	+	+	+/–

Figure 7: Overview of general advantages and disadvantages of different direct compensation models

Source: DNV GL; illustrations based on USEF

These findings are based on the following observations for the different approaches for compensating the bulk energy issue:

1. No compensation: The first option recaps the option that there is no explicit compensation of the bulk energy issue at all and that the supplier has to bear the consequences from DR activated by independent aggregators. As outlined above, this may trigger inefficient DR activations and is

[31] For a conceptual overview please see "USEF: Work Stream On Aggregator Implementation Models - Recommended practices and key considerations for a regulatory framework and market design on explicit Demand Response"

probably economically inefficient also in the long-run. In addition, it is unfair as the aggregator does not pay the sourcing costs and it likely distorts the level playing field among retailers leading to negative distributional effects among suppliers.

2. Compensation by the independent aggregator to the supplier will largely avoid inefficient activations of DR and will therefore increase its economic efficiency. The DR potential will be limited to a degree that is economically feasible and efficient from an overall system perspective. Moreover, as the aggregator would be fully liable for compensating the sourcing costs of energy, the approach complies with a general principle in the power market. Finally, due to the direct compensation of the bulk energy induced on the supplier the distributional effect on the retail market will be avoided.

3. Direct compensation by the flexible consumer will also offset the bulk energy issue. Whenever DR is activated, either as load shedding or load increase, the flexible consumer would pay for that amount of energy that would have resulted in the absence of DR activation. It provides for direct compensation after each DR activation. Compensation is made at the agreed supply price.[32]

   It should be noted that this approach is different from not compensating the supplier directly and letting him decide whether to allocate the extra costs from independent DR activation to the flexible consumer or its other customers.

   It may be assumed that the flexible consumer will take the additional costs from compensating the supplier into account when agreeing with the aggregator on the split of remuneration from DR activation. Hence, the aggregator will be able and forced to internalize the spill-over effect on the supplier. The direct settlement between the supplier and the flexible consumer after each DR activation would then have the potential to ensure efficient use of DR as if there were direct compensation made by the aggregator to the supplier. This approach increases the economic efficiency of DR activated by independent aggregators, provided the contractual arrangement between the flexible consumer and the aggregator allows for it,[33] and avoids negative distributional effects on the retail market.

   However, the flexible consumer is probably required to treat information about its supply tariff confidential. Therefore, the information to the aggregator will be imperfect. This limits the scope for economically efficient activation of DR. And while the supplier is compensated for the energy sourced, situations may still occur where the aggregator re-routes energy to the market without fully paying for it.

4. Under the approach of socialisation of the costs associated with the bulk energy issue, the supplier is directly compensated by a levy that is paid by many system users (not only customers of the supplier), presumably via their supply tariff. An advantage of this approach is that it leaves the retail market unaffected, if the levy is designed in the appropriate way.

   As the aggregator is freed from compensation, the levy works as some form of subsidy. Hence, the incentives for DR activation are high and may still trigger inefficient DR activation. Assuming the regulated compensation is perfect, the supplier will recover all sourcing costs. However, the aggregator will still not bear the sourcing costs of the energy it re-routes to the market.

[32] A similar compensation mechanism is being contemplated in Germany for offsetting the spill-over effect of DR for the provision of balancing power.

[33] For this reason, the aggregator might finally pay also for the sourcing costs in case of load shedding.

Provided there is full coverage of the sourcing costs, there will be no distributional effect on the retail market. However, this holds true only if the regulated compensation / socialisation mechanism is ideal and does not over-/undercompensate any supplier.

Socialisation also means the economic inefficiency issue is shifted from the supplier to levy payers. Socialisation of the negative spill-over effects of DR may be considered rather unfair as it is unclear whether levy payers will be overcompensated by the benefits of DR on supply prices. Spreading the costs from DR activation widely is probably only justified in case it is demonstrated that those who will bear the costs will be over-compensated by lower electricity prices in the long run.

ANNEX A: OVERVIEW OF COMPENSATION SCHEMES IN FRANCE AND GERMANY

In many countries, there are specific regulatory provisions that support DR. Sometimes national regulation provides only for the combination of a retailer being at the same time a DR aggregator. In some other jurisdictions, independent DR aggregators are recognized as a separate market player. Moreover, countries differ in the scope for offering DR flexibility to the market. Differences arise due to a lack of regulation, institutional market entry barriers or insufficient market incentives.

Amongst others, France and Germany have adopted specific regulations on independent DR aggregators. We note that there are other countries that have taken no decision yet in this respect or have decided differently.[34] Hereafter we give a tabular overview of selected mechanisms in France and Germany and summarise its main features. Due to the heterogeneity of market segments that are in principle feasible for DR participation and the complexity of national market rules that one needs to consider, we limit the analysis to key regulatory elements for supporting the role of independent DR aggregators[35].

- In France, the NEBEF mechanism[36] ensures the market access of independent DR aggregation services to the wholesale market and the market for manual frequency restoration reserve.

  The compensation mechanism provides for offsetting the bulk energy issue based on an administrative price. The price is paid by the aggregator, while the TSO acts as intermediary and compensates the supplier for each DR activation. Due to this compensation by the aggregator one may doubt whether NEBEF is compatible with the new EU regulation Art 17.3.

- While still under contemplation by the national regulatory authority, the mechanism proposed in Germany[37] is limited to a formal set of rules for the deployment of DR by independent aggregators for the provision of balancing power. It covers, in principle, flexible consumer both with and without the need for rebound.

  The mechanism provides for full compensation to the supplier. In the interim period until end of 2019, there will be an energy transfer from the supplier's to the aggregator's BRP. The transfer refers to imbalances in the supplier's portfolio that may be attributed to DR. The imbalance is defined as the difference between the baseline (theoretical consumption without DR) and factual consumption for the time of the DR activation (as an exchanged day after schedule). It is planned to have a volume correction by the TSOs as a final solution for that imbalance/difference after 2020.

  In the final stage of this approach, the volume correction will also apply to the rebound. For this purpose, all consumers are categorized as either with rebound or without rebound potential. The mechanism is designed to grow in two steps: In the first step, consumers will be analysed with regards their rebound potential and adequate baselines. In the second step, volume correction will be applied also to the rebound period.

  Financial compensation to/from the supplier for the energy that was taken/given by the aggregator is ensured by direct compensation/credit note with the flexible consumer. Compensation refers to the difference between the consumer's factual consumption and the baseline that is attributable to DR.

[34] Paolo Bertoldi et al. (JRC); Demand Response status in EU Member States; 2016

[35] The discussion of DR activated by suppliers by large consumers active at the wholesale market is beyond the scope of this report.

[36] See e.g. RTE website; Le mécanisme d'effacement NEBEF; 2017

[37] „Branchenleitfaden: Regelleistungserbringung durch Drittpartie-Aggregatoren gem. §26a StromNZV", 5.12.2016

Overall, the compensation mechanism will remove both the imbalance and the bulk energy issue from the supplier (apart from imbalances out of rebound in the interims period). Without engaging in a deeper analysis, we assume that the mechanism proposed in Germany will be compatible with the EU proposal.

Table 2: Comparison of mechanisms for compensation of effects from independent DR activation available in Belgium, France and Germany

	Mechanism	France: NEBEF	Germany*
Scope	**Load shedding / increase**	✓	✓
	Rebound		✓
Market segments covered	**Wholesale**	✓	✘
	Balancing energy	✓	✓
	other	✘	✘
Compensation of …	**Imbalances induced on S (or its BRP respectively)**		
	Change in bulk energy sales of S		
	Compatibility with EU proposal	✘	✓

**„Branchenleitfaden: Regelleistungserbringung durch Drittpartie-Aggregatoren gem. §26a StromNZV", 5.12.2016*

Source: DNV GL

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