MARKET DESIGN FOR DEMAND SIDE RESPONSE

Policy Paper • November 2015

Demand Side Response (DSR) is a **key feature of the European electric system** for achieving its ambitious energy policy objectives. With this paper, ENTSO-E contributes to the on-going discussion on the integration of DSR in all electricity markets, which is currently progressing at a fast pace thanks to the works of the Smart Grid Task Force EG3 led by the European Commission and the involvement of stakeholders such as Eurelectric and the SEDC.

European Network of
Transmission System Operators
for Electricity

entsoe

EXECUTIVE SUMMARY

There are six key requirements for unleashing the potential development and efficient use of DSR.

1. **Price signals need to reveal the value of flexibility for the electricity system.**
2. **Efficient use of DSR is based on an economic choice between the value of consumption and the market value of electricity.** This choice arises when the consumer is exposed to variable prices or if the consumer can sell its flexibility on the market, possibly with the help of an aggregator.
3. **Access to price information, consumption awareness and DSR activation require strong consumer involvement, which can be facilitated with automation or by delegating the DSR process from the consumer to a company**.
4. **Regulatory barriers, when present, need to be removed to unlock full DSR potential, including barriers related to the relationship between independent aggregators[1] and suppliers.** Any evolution must preserve the efficiency and well-functioning of markets and their design components, such as the pivotal role of balance responsible parties, their information needs and balancing incentives. From a TSO perspective, the choice of the market model results from a trade-off between the imperatives not to increase residual system imbalance and to facilitate the development of additional resources.
5. **DSR should develop itself based on viable business cases.** Subsidies should remain limited and clearly identified.
6. **Communication and control technologies need to enable DSR for small consumers and provide guarantees on their reliability.**

[1] Aggregators independent from supplier's BRP.

Market design solutions have to address these six points: we are actually seeing across Europe that these models are being tested.

This paper provides an overview of market design options for DSR integration in day-ahead, intraday and balancing energy markets. DSR will also have a major role to play in reserves capacity markets, provided it meets reliability requirements.

These market designs are in an early phase and pursue the same objective: Get the demand side response potential untapped. Because we are in the early days of demand side response, a certain period of testing and experimentation is required. Most options are not mutually exclusive, and the choice of relevant solutions can depend on local context and conditions. Over time, convergence of models will appear as a result of benchmarking and mutual learning.

1 INTRODUCTION

The European Commission stated that **"any review of the market design must […] create conditions […] allowing for the cost-effective integration of new types of flexible demand into the market"**[1]. In line with this policy, ENTSO-E recently advocated the further development of DSR and highlighted the numerous associated benefits, from the reduction of energy costs for consumers to making the system more flexible and increasing competition to the markets[2].

This requires the paradigm of inflexible demand to be shifted. While this evolution is to the benefit of all market actors, it is important to ensure the development of a market model that values demand flexibility. This will allow unlocking the DSR potential while preserving adequate incentives (especially balancing incentives) on all market players.

At the core of this challenge lies the fundamental requirement to define an appropriate market design by setting roles and responsibilities and configuring all market mechanisms in a way that improves the participation of demand. For an efficient representation of the demand side, consumers should be able to better react to market prices. This implies that all relevant markets are opened further to competition of DSR with other resources on non-discriminatory, fair and transparent terms.

Presently, there are technical, financial and organisational challenges for end consumers' participation in markets. The technical challenges are no longer the main limiting factor for DSR development. The economic potential for DSR can be revealed with a market design enabling its technical potential, taking into consideration associated costs and added value. Further opening of day-ahead, intraday and balancing energy markets, as well as reserve capacity markets, is necessary to fully enable participation of all DSR players. The development and efficient use of DSR require several conditions to be considered.

THIS PAPER BUILDS ON PREVIOUS RECOMMENDATIONS, DETAILING HOW TO BUILD AN APPROPRIATE MARKET DESIGN FOR DSR.

The paper presents the conditions for the development and efficiency of DSR in sections 2 to 7. Section 8 gives an overview over different market design options to integrate DSR into the day-ahead, intraday and balancing energy markets and over DSR participation in reserves capacity markets. Further explanations are given in Appendix 2 and 3. An overview of the European legislative and regulatory framework for DSR is given in Appendix 1.

[1] Communication from the Commission launching the public consultation process on a new energy market design, 15/07/2015.

[2] ENTSO-E, Demand Side Response Policy Paper, 15/09/2014.

2 PROPER MARKET PRICE FORMATION

As highlighted in earlier work[1)], one of the main challenges for the European electricity system is the **lack of effectiveness of price signals** to stimulate appropriate investment and performances.

Accurate short-term market price formation is needed to reveal the value of flexibility in general and of DSR specifically. Proper energy price formation in the day-ahead, intraday and balancing[2)] energy markets requires not only that DSR activations are based on price signals, but also that the price signal reflects DSR activations.

[1)] ENTSOE, Market Design Policy Paper, 15/09/2014.

[2)] E. g., close to real time price dissemination, incentive-based imbalance pricing.

DSR participation in reserve capacity markets will increase competition and improve reserve capacity price formation.

Distortions can also exist outside the electricity sector and impact the retail level, for instance, with other competing commodities such as gas or heat. Cross-market consistency between commodities that can be substituted for one another (e. g., electricity and heat) is necessary to enable efficient use of DSR in the electricity market, and particular attention should be paid to differences in taxation, grid tariffs and regulation.

3 COST REFLECTIVE CONSUMER PRICES

Efficient DSR is based on an **economic choice** between the value of consumption and the value of non-consumption or postponement of consumption.

The value of consumption is the utility the consumer has from energy use, while the value of non-consumption is the market value of the associated products (commodity, imbalance) or the cost of alternative energy sources (e. g., oil, gas, biomass, batteries). In certain countries, however, for most customers (especially households and small and medium-sized enterprises), the variability of such market value is not perceived because electricity supply contracts are stipulated with fixed prices that do not enable consumer choice other than changing suppliers.

A possible approach to enable that choice is to expose the consumer to prices reflective of the energy cost at the time of consumption and to react to changing electricity prices. This, however, requires appropriate price incentives. While this is already the case in several retail markets – because consumers can sign supply contracts using, e. g., hourly DA price references – in some other markets, the level of consumers' price exposure is limited by the relatively low proportion of the energy component in the final electricity cost (including taxes, levies and grid tariffs).

Another possibility for the consumer is to sell its flexibility on the market, either directly or via a third party such as an independent aggregator. Such an approach normally requires a baseline methodology to determine and control the amount of energy or power delivered. This baseline methodology[1)] should be carefully considered and – while open to several options – based on consensus of relevant stakeholders.

Efficient price exposure requires accurate allocation of energy based on actual metering, with a precision in metering adapted to each product. Regulated smart meters and continuous metering can enable DSR and must be used as references wherever available. If they are not available or sufficiently accurate for specific DSR products, a robust and appropriate regulatory framework can enable alternative metering solutions. For instance, TSOs can decide to certify the metering process of DSR providers of balancing services and use their data for balancing products.

[1)] Load scheduling where available can be used as a baseline; for balancing energy, alternative solutions are available.

4 PRICE INFORMATION AND PHYSICAL POSSIBILITY TO ACT

Efficient DSR requires all involved parties to take **appropriate actions**, which require **relevant price information** and the **physical possibility to act**. However, in some markets, access to price information and the physical action to trigger DSR can incur significant transaction costs for the consumer, especially for small consumers and complex products.

Open access to market prices, full transparency on price formation and market rules both at retail and wholesale levels are necessary. Consumers' involvement, however, requires that for small consumers, price signals remain understandable and manageable. Consumption awareness is necessary to identify DSR potential, which can be difficult not only for households but also for industrial consumers since it requires dedicated expertise. This expertise is a core business activity for companies developing DSR resources such as aggregators and retail companies.

The activation of DSR can be done by the consumer itself, either manually or through predefined procedures. It can also be automated, which significantly reduces transactions costs for consumers. Alternatively, the activation process can be delegated and performed by another entity such as the supplier, an independent aggregator, a service provider or a TSO in an emergency situation. Standardisation of interfaces between technologies, for instance, to ensure the compatibility of communication protocols, can also reduce transaction costs while avoiding slowing down innovation.

5 A FRAMEWORK FOR DSR

Market access for DSR is the possibility for the consumer to **participate in all relevant markets** either directly via its supplier or through an independent aggregator. However, many markets today have barriers to entry for DSR players.

In several markets, processes and regulatory frameworks were designed when the potential for DSR was considered limited. At the same time, in countries where a specific market design is being implemented for DSR, regulatory instability can negatively affect implementation efforts.

Market access for DSR is not sufficient in itself because all interactions with other stakeholders must be carefully considered and managed. Particular care must be paid to preservation of the pivotal role of balance responsible parties (BRPs) in the market design. BRPs are financially responsible for balancing their own positions; by doing so, they contribute to the balance of the electricity system. New evolutions (e.g., growing share of renewables, demand flexibility, interventions of third parties) increase the complexity and risks related to the responsibilities of BRPs. Therefore, it is essential that BRPs are correctly informed to be able to fulfil their role, thereby avoiding counterbalancing and ensuring proper forecasting. The correct balancing incentives and the provision of means for BRPs to be balanced require careful consideration in market design evolutions and raise implementation challenges.

Market participation of DSR can be facilitated by the design of products[1] or markets. For instance, bid size, bid time and/or gate closure time should be considered. On the other hand, aggregators or large consumers themselves have a core competence in transforming the underlying complexity of DSR resources into generic products. The right balance must be found when adapting balancing products to DSR to avoid an unintended delegation of the aggregation business to TSOs. Alternatively, power exchanges operating day-ahead and intraday markets can play a role, for instance, with "flexible bids" that typically reflect the energy constraints of storage or DSR assets.

1) ENTSO-E, Demand Side Response Policy Paper, 15/09/2014.

6 A BUSINESS CASE FOR DSR

The willingness of demand side actors to participate in the market essentially depends on the **economic incentives** they receive, i.e., the existence of a business case and the correct allocation of the benefits it brings.

This business case is influenced by economic factors such as energy price volatility, implementation and operational costs, as well as the competitiveness of alternatives such as non-participation, switching to other energy sources, etc. The economic efficiency of DSR is, and should remain, the primary driver for its development. Other aspects that can increase consumers' willingness to develop DSR are the ability of

DSR activations to be performed smoothly and not impact normal business activities and the possibility to value the positive image of DSR activities.

Economic viability of DSR also involves competition issues. If consumers want to offer DSR through an independent aggregator, the resulting unbundling between supply and flexibility creates value by opening an alternative growth path for DSR on the offer side of the market. Hence, consumers themselves optimise the economic value of DSR when pursuing their own commercial interest, thereby negotiating the flexibility clauses of their supply contract or a dedicated flexibility contract with an independent aggregator. Sufficient competition between energy suppliers on one side and independent aggregators on the other is key for consumers to have the negotiating power to optimise the economic value of their flexibility.

For DSR to benefit society as a whole, the potential introduction of subsidies must remain limited to what would strictly be necessary to achieve policy objectives and kick-start DSR development. There should be a clear and clean separation between economic subsidies and market design, avoiding hidden biases: DSR must achieve its full economic potential in fair competition with other sources. Moreover, in cases deemed necessary, subsidies for DSR must be designed to prevent any market distortion, especially in the energy market, since it would have cross-border impacts. Ensuring costs are appropriately shared and recovered will facilitate the choice of innovative solutions.

7 COMMUNICATION AND CONTROL TECHNOLOGY

Emerging technologies and automation are important tools for DSR participation in the markets. TSOs and DSOs need to support and implement solutions that include **communication and control technologies** enabling DSR for small consumers, such as multiple use of Advanced Metering Technology/smart meters and steering components for boiler reserve control.

IT and technology are constantly developing, so when developing solutions for demand-side response it is important to anticipate future technological evolutions. The most optimal solution in the current technology framework is not necessarily the most optimal solution in the future.

System operators have and will maintain extremely high requirements for reliability for system reserves because they are necessary to ensure overall system security. Those reliability requirements could, however, be secured with innovative approaches for new resources like decentralised DSR. For instance, as we move towards systems with a large number of smaller units, a more probabilistic approach to reliability could avoid unnecessarily and prohibitively high costs. Such possibilities require careful assessment to ensure that the level of reliability is not impacted.

Reliability requirements must be an integrated part of technical and market rules and pre-qualification terms for DSR product delivery. Information flow between relevant parties must ensure that information access supports competition and good market practice and meets market parties' need of clarity.

8 MARKET INTEGRATION OF DSR

To facilitate the participation of DSR, **different models** exist or are being implemented.

Appendix 2 describes market design solutions to integrate DSR in day-ahead, intraday and balancing energy markets and further unlock DSR's potential while preserving efficient overall market functioning. Figure 1 lists those options and presents how they are classified, first considering whether DSR is integrated with supply or not, and in the latter case, whether a bilateral agreement between the independent aggregator and the BRP/supplier is necessary.

From a market design perspective, an integrated approach for supply and DSR is the simplest way to implement DSR and avoids interfering with other stakeholders. However, it does not allow aggregators to operate independently from suppliers, which may prevent unlocking the full DSR potential in some markets. Complementing this model with other solutions should thus be considered. The economic efficiency of the variable supply price model, compared to the supplier load control model, is reduced if there is a significant gap between energy retail and market prices.

The bilateral agreement model allows independent aggregators to operate with a low degree of complexity. It ensures fairness for impacted stakeholders because they express consent in the agreement. The economic efficiency of this model depends on the conditions in the contracts. Competition concerns might occur for independent aggregators because their participation depends on the goodwill of the supplier/BRP source, although this could be solved with regulated, enforceable standard contracts.

Market designs without bilateral agreement ensure pre-contracting confidentiality and allow independent aggregators to act without consent from suppliers/BRPs. In addition, some of these models make post-contracting confidentiality of DSR activations possible, which further reinforces competition between suppliers and independent aggregators. Economic efficiency is ensured if the price to settle the transfer of energy with suppliers is cost-reflective. However, such solutions require heavy and complex evolutions of the market design, which will take time to develop.

Furthermore DSR can be integrated in capacity reserve markets. Reserve capacity products can be considered insurance or hedging products which value guaranteed availability, as described in other ENTSO-E position papers. Such products are procured by TSOs, or traded between market parties, in reserve capacity markets, and – when activated – are used to balance the system (see Appendix 3 for further details).

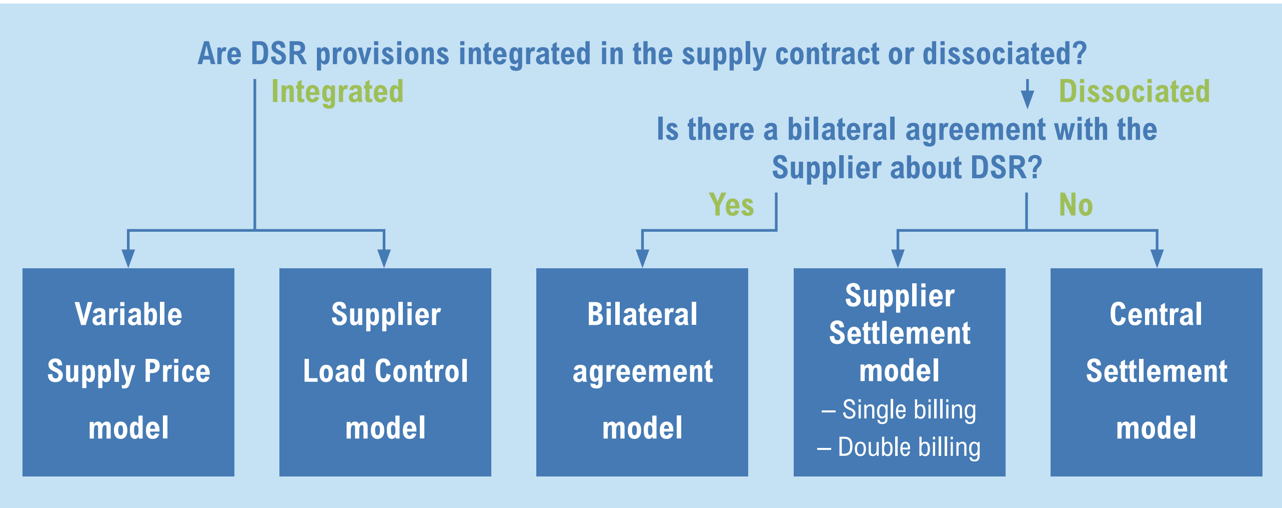


Figure 1: Overview of Market Design Options for DSR Integration in Energy Markets

9 RECOMMENDATIONS AND NEXT STEPS

Further market integration of demand-side response is crucial to enable its **efficient use and economic viability**. Development of DSR should ensure that demand elasticity is adequately reflected in short-term price building and long-term investment incentives. DSR can deliver different types of products and participate in the associated markets with **large socio-economic welfare gains**, but this is not straightforward and raises several challenges.

These challenges can be overcome with concrete market design solutions that already exist and are being implemented or experimented with in Europe. Most of these solutions are not mutually exclusive and can be considered as complementary approaches for gradual implementation to unlock more DSR potential.

SELECTION OF MARKET MODELS

As a good practice, countries can consider the selection of these market models. Implementation choices should be driven by cost-benefit analyses accounting for local context elements and conditions such as economic efficiency, competition, fairness, complexity, robustness and the potential to unlock additional flexibility. Particularly important are considerations about competition among all DSR market actors and potential barriers to new entrants, since these will influence the regulatory choice of whether DSR should be operated only directly, via suppliers, or via third parties such as independent aggregators. A market model safeguarding commercial post-contracting confidentiality for aggregators might facilitate further the development of independent aggregators but might also have a negative impact on the balancing quality of BRPs due to lack of information for balancing and forecasting needs.

DSR INTEGRATION IN ENERGY MARKETS

The complexity of DSR integration in energy markets must not be underestimated. Any evolution must preserve the efficiency and well-functioning of markets and their design components, such as the pivotal role of balance responsible parties, their information needs and balancing incentives. From a TSO perspective, the choice of the market model results from a trade-off between the imperatives not to increase residual system imbalance and to facilitate development of additional resources.

DSR PARTICIPATION IN RESERVES CAPACITY MARKETS

DSR participation in reserves capacity markets can represent in some countries a large part of DSR's economic potential provided it features a high level of reliability, including data management and security requirements. This additional potential to reserves will be crucial for TSOs in such countries to operate the system as it includes more and more fluctuating RES, which would give these TSOs, together with the customers, a key coordination role between all DSR products in the market design for DSR.

APPENDIX 1: EUROPEAN LEGISLATIVE AND REGULATORY FRAMEWORK FOR DSR

ENERGY EFFICIENCY DIRECTIVE ARTICLE 15.8

Member States shall ensure that NRAs encourage demand side resources, such as demand response, to participate alongside supply in wholesale and retail markets. […]

Subject to technical constraints inherent in managing networks, Member States shall promote access to and participation of demand response in balancing, reserve and other system services markets, inter alia by requiring NRAs or, where their national regulatory systems so require, TSOs and DSOs in close cooperation with demand service providers and consumers, to define technical modalities for participation in these markets on the basis of the technical requirements of these markets and the capabilities of demand response. Such specifications shall include the participation of aggregators[1]*.*

[1] The Energy Efficiency Directive defines aggregators as a "demand service providers that combine multiple short-duration consumer loads for sale or auction in organised energy markets".

PROVISIONS IN NETWORK CODES RELEVANT FOR DSR

Taking into account this legislative context, the Network Codes drafted by ENTSO-E, and in particular the Network Code on Demand Connection (NC DC), oblige TSOs/DSOs to facilitate DSR for system reserves. The NC DC defines system services requirements necessary for keeping the system stability and resilience in both normal and alert system states, in addition to emergency situations. These include active power control, low frequency demand disconnection, reactive power control, transmission constraint management and system frequency control. Reactive power control is not an energy balancing function but is required for voltage control.

The Network Code on Electricity Balancing (NC EB) requires that standard products are defined for the European balancing market (energy and reserves markets) to move towards a single European market with a cross-border regional approach. In the formation of cross-border regional markets, operational security constraints and technical network constraints will need to be considered. The NC EB defines products based on processes defined in the Network Code on Load Frequency Control and Reserves (NC LFC&R), such as frequency restoration reserves and replacement reserves. Work is ongoing with definitions on standard products that will be subject to approval by ACER.

The NC DC and NC EB will provide a framework for demand side participation. In addition, the NC LFC&R obliges TSOs to ensure pre-qualifications and verification of actual delivery from providers of products defined according to NC EB.

As concrete examples, the NC EB states that *"pricing methods for each standard product for balancing energy shall strive for an economically efficient use of demand-side response and other balancing resources subject to operational security limits"* (Recital 13), that *"[…] the participation of demand-side response including aggregation facilities and energy storage [is facilitated]"* (Art. 10.1h) and that *"the terms and conditions for balancing service providers shall allow the aggregation of demand-side response […]"* (Art. 27.4a).

APPENDIX 2: INTEGRATION OF DSR IN DAY-AHEAD, INTRADAY AND BALANCING ENERGY MARKETS

Market access for DSR is already possible in several European markets, however, some barriers remain. To facilitate the participation of DSR, different models exist or are being implemented. This Appendix describes market design solutions to integrate DSR in day-ahead, intraday and balancing energy markets and further unlock DSR's potential while preserving efficient overall market functioning. In doing so, ENTSO-E recognises the current diversity of European electricity retail markets. The solutions presented, while not necessarily mutually exclusive, may not be suited to all national contexts, especially since some markets have various degrees of DSR implementation and competition.

Figure 1 lists those options and presents how they are classified, first considering whether DSR is integrated with supply or not, and in the latter case, whether a bilateral agreement between the independent aggregator and the BRP/supplier is necessary.

EACH MARKET DESIGN OPTION WILL BE DISCUSSED BASED ON THE FOLLOWING PRINCIPLES.

- **Economic efficiency:** Does the model allow for basing DSR activations on an efficient optimisation between the market value and usage value of energy? Does the end consumer benefit from such DSR activations? Does the market design ensure the efficiency of existing balancing incentives?
- **Fairness:** Are market rules fair for all impacted stakeholders, including the final customer? What about the impact on the retail market?
- **Competition:** Does the model remove existing barriers for newcomers and create a level playing field between all market parties? Does the model ensure appropriate balance between commercial confidentiality and transparency for market functioning?

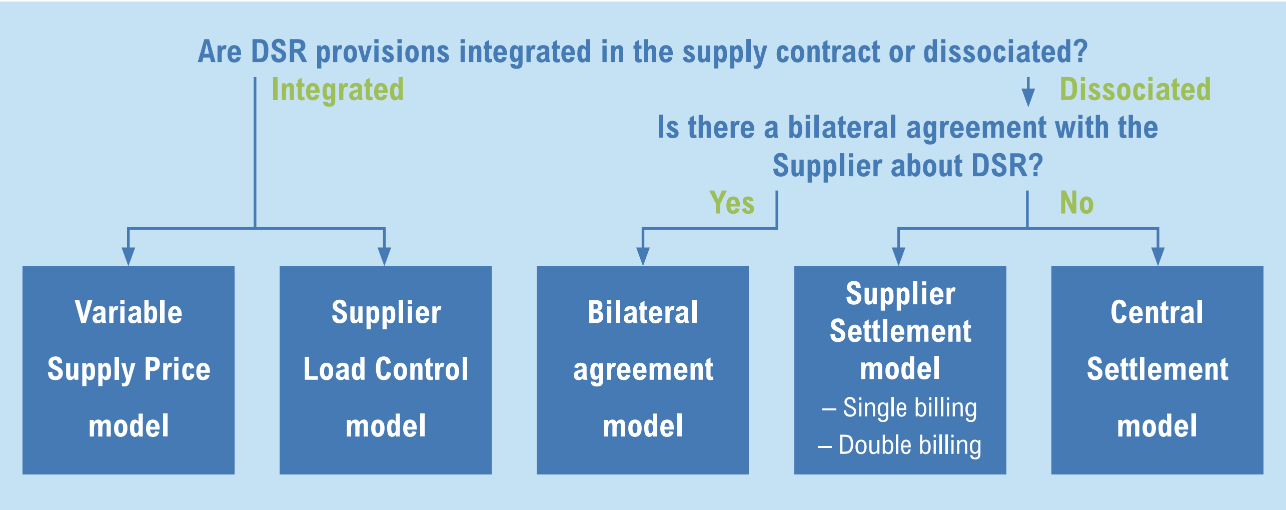
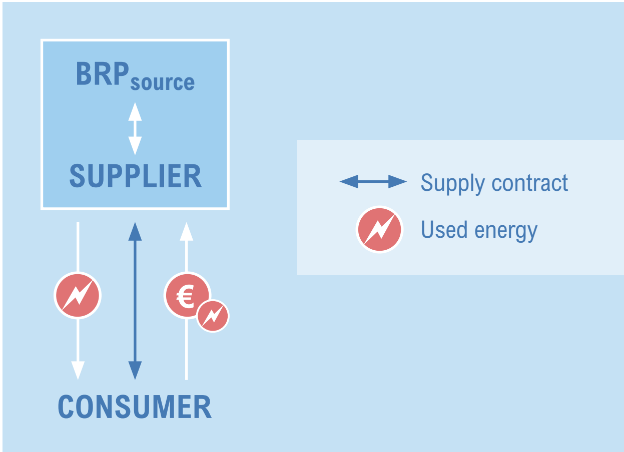


Figure 1: Overview of Market Design Options for DSR Integration in Energy Markets

- **Complexity:** How complex is implementing this market design option? What is the impact for system operators, aggregators, BRPs and suppliers? Once the market design is implemented, how complex is it for stakeholders to perform a DSR activity and correctly process it end to end?
- **Robustness:** Does the model address the pivotal role of the BRPs in terms of information provision to the BRP to fulfil its balancing obligations? Does the model allow both upwards (decrease consumption or increase generation) and downwards activation (increase consumption or decrease generation)? Is the same solution possible for decentralised production?

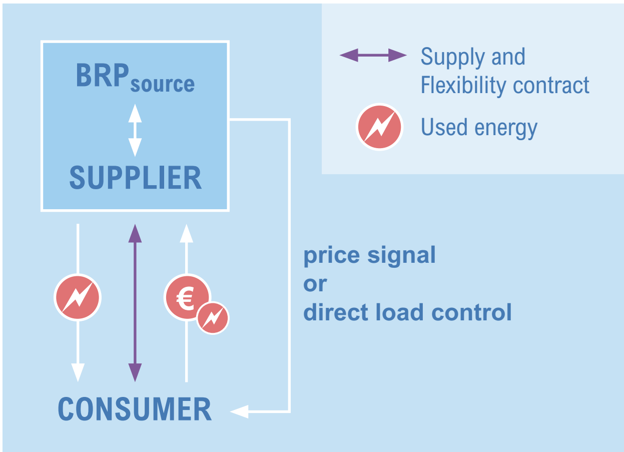
The proposed market designs are centred on the consumer, which has a supply contract with a supplier. This supplier is part of the portfolio of a BRP referred to as "BRP source", which sources energy on the market to cover the demand of the supplier's consumers. In some market designs, the consumer itself or an independent aggregator on its behalf can have a market activity, which formally requires association with a BRP to access the energy market or being a balance service provider (BSP) to access the balancing market.



1. MARKET DESIGNS WITH INTEGRATED SUPPLY AND DSR SOLUTIONS

Suppliers are at the interface between consumers and markets and therefore are well placed to value DSR. Flexibility clauses can be integrated in a supply contract, giving the supplier additional tools to optimise its portfolio and reduce sourcing costs. In return, the consumer may reduce its costs compared with a standard supply contract.

No other market participant is impacted, and all details are settled in a bilateral contract between supplier and consumer. Two market design solutions can be implemented, depending on whether the consumer receives price incentives or direct load variation orders from the supplier.



A. VARIABLE SUPPLY PRICE MODEL

In this model, the consumer pays the supplier a variable supply price. The possible variations of the supply price are set contractually, and the consumer can adapt its consumption in response to price variations. Supply price indexation on market prices makes the price signal more accurate, but also more risky and complex to manage for consumers. The supplier anticipates the behaviour of the consumer in response to the price signal. This information is used by the BRP source to balance its portfolio. This model represents a large share of existing DSR in Europe, notably for small consumers equipped with smart meters.

B. SUPPLIER LOAD CONTROL MODEL

The flexibility clause in a supply contract can provide for direct supplier load control in specific situations. In such cases, the consumer is expected to curtail its load of a predefined volume at the request of the supplier, which can then be used by the BRP source to take part in balancing markets, self-balance its portfolio or benefit from high market price situations. This type of integrated supply and flexibility typically targets industrial consumers.

From a market design perspective, a bundled approach for supply and DSR is the simplest way to implement DSR and avoids interfering with other stakeholders. However, it does not allow aggregators to operate independently from suppliers, which may prevent unlocking the full DSR potential in some markets. Complementing this model with other solutions should thus be considered. The economic efficiency of the variable supply price model, compared to the supplier load control model, is reduced if there is a significant gap between energy retail and market prices.

2. MARKET DESIGNS WITH DSR DISSOCIATED FROM SUPPLY

Market designs dissociating DSR from supply require giving direct market access to the consumer or to an independent aggregator on its behalf to sell DSR on the market. Access to the day-ahead and intraday energy markets is organised via a BRP.

SPECIFIC MARKET DESIGN ISSUES ASSOCIATED WITH DSR DISSOCIATED FROM SUPPLY

Allowing an independent aggregator to participate in the day-ahead, intraday or balancing energy market is not straightforward and raises conceptual challenges. It also has collateral impacts on the supplier and on the BRP source. Four major issues need to be addressed.

TRANSFER OF ENERGY

When performing a DSR-activation, an independent aggregator transfers energy from the BRP source or supplier to another market party. This transfer of energy must therefore be associated with fair compensation between the independent aggregator and BRP source or supplier (while preserving balancing incentives). The fairness of this compensation requires covering the sourcing cost of the BRP source/supplier, which could require accounting for their different sourcing strategies and types of consumers while not creating excessive risks for independent aggregators. If this is not done appropriately, due to risk management reasons, suppliers might start redefining their sourcing strategy depending on the compensation price. On the other hand, full exposure of independent aggregators to the sourcing strategy of suppliers could threaten their viability.

BRP SOURCE IMBALANCE RISK

A DSR activation for balancing purposes impacts the balancing perimeter of the BRP source because the latter is put in imbalance without any control or forecasting possibility over it. This is referred to as "BRP source imbalance risk". Consequently, the BRP source should be compensated for those imbalances. An additional issue might be potential deviation between energy sold by the aggregator to a third party and actual energy activated. It is important to clearly assign that deviation.

INFORMATION TO BRP SOURCE AND SUPPLIER

BRPs play a pivotal role in the electricity market. To maintain a balanced position, BRPs actively forecast their generation and demand in their balancing perimeter to the same extent as suppliers do with their customer portfolio. By balancing their own positions, BRPs support the balance of the whole electricity system. If not aware of DSR activations, the BRP source could counterbalance that by reducing (or increasing) generation. Therefore, an accurate assessment of the modification of consumption (or generation) is important to avoid erroneously interpreting it as normal customer behaviour. Finally, BRPs need to be able to check the impact of a DSR activation on their portfolio, allowing a correct settlement with other parties. Hence, for balancing, settlement and forecasting reasons, BRPs and/or suppliers should be informed timely and in an appropriate level of detail when a DSR activation has occurred.

CONFIDENTIALITY

A market design allowing dissociation of supply and flexibility should not be exclusive of bundled solutions. Independent aggregators and suppliers can therefore compete to get access to DSR potential. Since the identification and development of DSR potential is part of the core business for aggregators, if DSR activations are notified at individual levels to suppliers of affected consumers, suppliers can benefit for free from the identification efforts of the aggregators. Therefore, a certain level of confidentiality needs to be assured. However, lack of transparency may be an important barrier to facilitating competition among different types of DSR operators. Confidentiality principles should similarly apply to suppliers and aggregators.

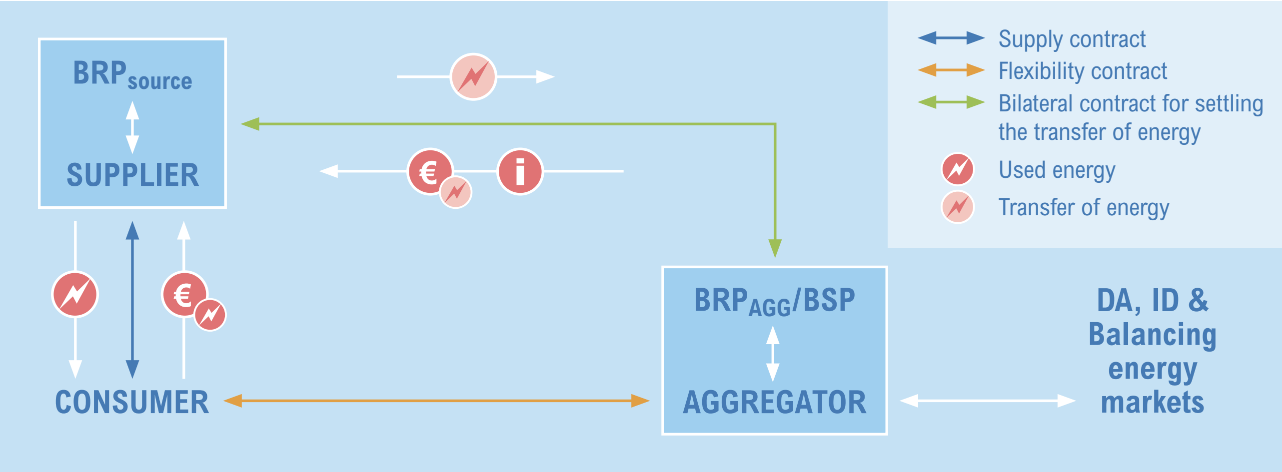
A differentiation is to be made between the pre- and post-contracting phase of a flexibility contract between an independent aggregator and the end user.

- **Confidentiality in the pre-contracting phase** means that the BRP source or supplier of the end user does not need to be informed that the end user is entering into a contractual relationship with an independent aggregator. As such, the end user and independent aggregator are not hindered in signing a flexibility contract. In a competitive retail market in which suppliers are willing to allow flexibility contracts at reasonable conditions, this might be a lesser concern.

- **Confidentiality in the post-contracting phase** means that the BRP source or supplier is not aware of a flexibility contract with DSR activations performed by independent aggregators in its portfolio and that all processes (activation, notification, settlement, etc.) are managed to maintain this confidentiality. It is technically challenging to achieve this because meter data has to be corrected to hide changes in consumption patterns.

At the same time, because end users will have growing opportunities to value their flexibility, they should also be made aware of the associated responsibilities. For instance, end users might have the contractual obligation to inform all relevant parties (supplier/BRP source) of changes in their consumption profile and has to ensure that there are neither gaps nor overlaps between the contracts they conclude (supply contract, flexibility contract, etc.). Hence, end users must be aware that the conditions of their supply contracts on DSR-activations can be important when comparing and negotiating with different suppliers.

Consequently, the "Information to BRP source" and "Confidentiality" issues can lead to contradictory requirements, with diverging interests between BRPs and aggregators. Correct balance between this post-contracting confidentiality and the necessary appropriate information to the BRP source or supplier can be found without compromising competition in DSR markets (between independent aggregator and supplier/BRP source and between independent aggregators), complexity and fairness principles. In practice, a choice needs to be made between safeguarding post-contracting confidentiality, potentially fostering further the development of DSR by protecting independent aggregators, and the potential risk of an increase of balancing needs because balancing quality of BRPs may be affected. Since ensuring both principles at the same time may increase the complexity of the associated market design, a choice on this trade-off needs to be made by policy-makers, taking into account the specificities of the market context.



A. BILATERAL AGREEMENT MODEL

The bilateral agreement model is a market design in which the independent aggregator and the BRP source conclude a bilateral agreement to solve the specific market design issues arising from the dissociation of DSR from supply. By nature, this model requires the supplier or the BRP source to be involved in the agreement. This requires a consideration of the impact of the confidentiality issue.

This bilateral agreement is a commercial contract between the independent aggregator and the BRP source or the supplier. However, it requires that both parties are willing to enter into such a contract; hence, competition issues can arise. If the BRP source/supplier refuses to sign bilateral agreements with independent aggregators, or only at an excessive transfer price, it can exert a form of monopoly over flexibility.

The introduction of standard contract templates defined by regulation can facilitate the conclusion of such contracts and provide for easier regulatory monitoring and competition oversight. If the aggregator is the consumer itself, the bilateral agreement can be included in the supply contract.

To solve the transfer of energy and BRP source imbalance risk challenges, the bilateral agreement covers the settlement of the transfer of energy between the BRP source and the aggregator in case of DSR activation. Typically, a bilaterally agreed-upon transfer price is paid between the BRP source and the aggregator for the energy sold on the market. Such provisions can take the form of a delegation of balancing responsibility from the BRP source to the independent aggregator.

The bilateral agreement model allows independent aggregators to operate with a low degree of complexity. It ensures fairness for impacted stakeholders because they express consent in the agreement. The economic efficiency of this model depends on the conditions in the contracts. Competition concerns might occur for independent aggregators because their participation depends on the goodwill of the supplier/BRP source, although this could be solved with regulated, enforceable standard contracts.

B. MARKET DESIGNS WITHOUT BILATERAL AGREEMENT

Market designs without bilateral agreement allow aggregators to act independently from suppliers. These models differ from the bilateral agreement model in the way the transfer of energy is dealt with and settled between parties.

In a market design without bilateral agreement, BRP source imbalance risk is solved by neutralising the activated energy (i.e., delta between baseline and metered energy) in the BRP source perimeter. During the imbalance allocation process, the calculated activated energy per BRP source and per imbalance settlement period is used to perform BRP source imbalance risk neutralisation and settlement based on the conditions of the existing BRP contract. Hence, the calculated activated energy is assigned to the BRP source perimeter. In the wholesale day-ahead and intraday markets, independent aggregators are associated with a BRP that assumes this balancing responsibility for the sold or requested energy from a DSR-activation.

In the balancing timeframe, any potential deviation between requested and activated energy is allocated to the independent aggregator either as an imbalance to its associated BRP or as an activation penalty to an independent BSP and is settled accordingly.

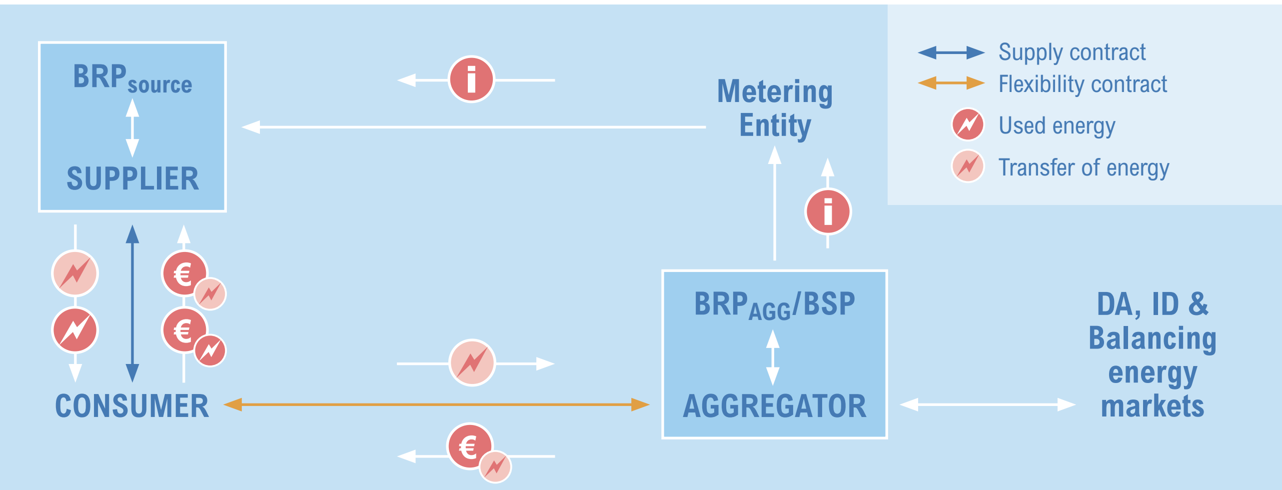
The information issue for BRP source is tackled by requiring independent aggregators to schedule DSR activations and inform the TSO and, if applicable, DSO, in a similar way as scheduling obligations apply for generation, including location information if relevant. The TSO informs the BRP source in due time with the requested flexibility activation to avoid counterbalancing.

In all the models below, the pre-contracting confidentiality issue is resolved. Subject to the national contexts, post-confidentiality might be an issue and might affect the choice for a specific market design.

A) SUPPLIER SETTLEMENT FOR DSR ACTIVATIONS

In this model, the energy sold on the market by the independent aggregator is invoiced to the consumer by the supplier as if it had been consumed. This way, the transfer of energy is settled directly between the consumer and supplier at the contractual supply price.

In case the aggregator is not the consumer, compensation from the DSR operator to the consumer is necessary, at least to cover the costs of the non-consumed invoiced energy. Such arrangements fall under the contractual relationship between the aggregator and the consumer.



Two different possible solutions can be implemented for the supplier to invoice the activated energy following DSR activation.

- **Single billing:** The supplier receives merged metering information for each consumer without distinction between the consumed energy and the energy of DSR activations. This merging process is performed by the metering entity, for instance, a DSO or the TSO. The model ensures post-contracting confidentiality. However, it could require implementation of complex additional corrective processes, e.g., if taxation differs between consumed energy and the energy of DSR activations.
- **Double billing:** For each consumer, the supplier receives separate metering information for the consumed energy and the energy of DSR activations from the metering entity. The consumer pays both energies at the supply price to the supplier. This model does not raise concerns regarding the invoicing of grid tariffs, taxes and levies. Moreover, it allows suppliers to have different ways of dealing with the transfer of energy issue per category of clients

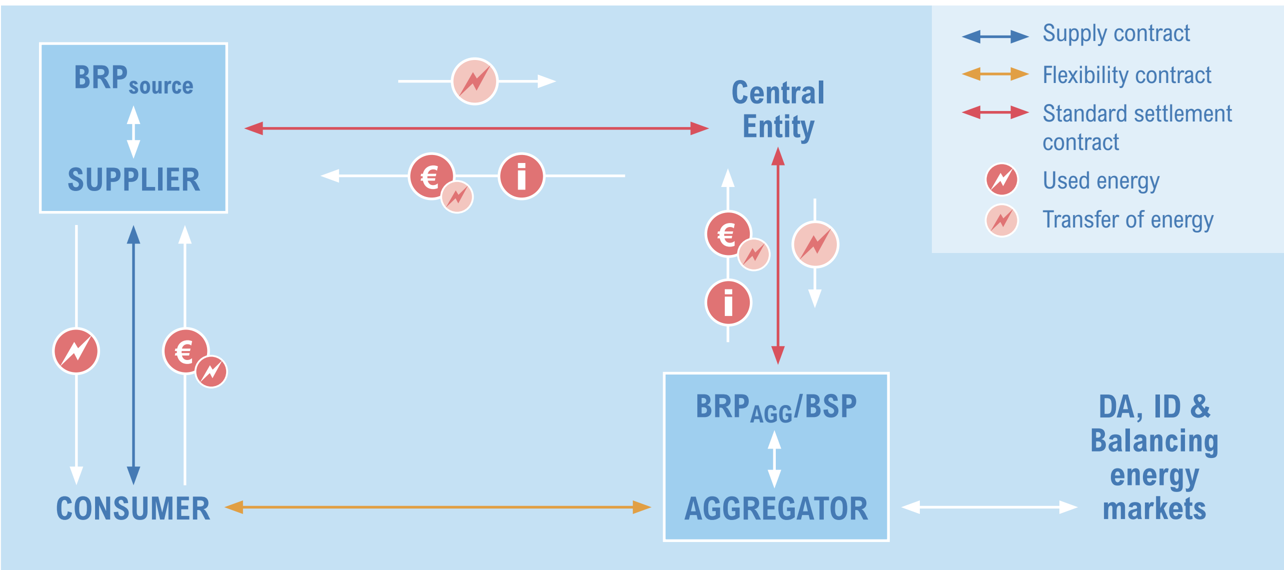
Both models have the advantage that cost reflective DSR bids from consumers or an aggregator on their behalf lead to efficient arbitrage between market prices and usage value without distortions in the merit order.

B) CENTRAL SETTLEMENT FOR DSR ACTIVATIONS

In this model, the settlement of the transfer of energy is performed by a neutral central entity, which can be a DSO, the TSO or a third party. The central settlement model requires a wholesale settlement price between the independent aggregator and the BRP source to settle the transfer of energy. This settlement price is:

- either the individual supply price of the activated consumers, which raises feasibility issues because it implies that all individual supply prices are centralised at this neutral entity; or
- a reference price that requires some form of regulatory approval. Such a price can be a segment price per type of customers or a price formula reflecting the market-based settlement price.

This model ensures post-contracting confidentiality for independent aggregators. However, the transfer price



can differ from the real supply price of impacted end users, which is not economically optimal. In cases in which a regulatory intervention determines the central settlement price, special care should be taken to preserve a level playing field between different actors in the market. Finally, depending on the chosen solution, such a transfer price might limit the degrees of freedom to suppliers in negotiating innovative supply contracts with end users.

Market designs without bilateral agreement ensure pre-contracting confidentiality and allow independent aggregators to act without consent from suppliers/BRPs. In addition, some of these models make post-contracting confidentiality of DSR activations possible, which further reinforces competition between suppliers and independent aggregators. Economic efficiency is ensured if the price to settle the transfer of energy with suppliers is cost-reflective. However, such solutions require heavy and complex evolutions of the market design, which will take time to develop.

APPENDIX 3: INTEGRATION OF DSR IN RESERVE CAPACITY MARKETS

Reserve capacity products can be considered as "insurance or hedging products", which value guaranteed availability. Such products are procured by TSOs, or traded by market parties, in reserve capacity markets, and—when activated—are used to balance the system. It is therefore a two-step process; first, the procurement of capacity, which ensures the ability to balance the system, and secondly, activation of these reserves in real time. Capacity reservation and actual activation have separate pricing depending on the market rules.

DSR often has a high capacity value relative to its energy value in many countries. Participation in reserve capacity markets therefore opens significant opportunities for the development of DSR and provides an additional revenue stream for DSR capacities that can match technical requirements. Such an additional revenue stream can be decisive for DSR development in some markets.

As stated in Appendix 2, DSR requires significant adaptations to allow its participation in energy markets. This is not the case for reserve capacity markets, for which DSR participation is much easier than in energy markets. However, reserve capacity products are activated at one point or the other, which may raise similar issues for the treatment of the associated energy as the ones arising for DSR participation in energy markets. DSR participation to the corresponding market must in such cases be associated with one of the models described in the Appendix 2.

If the value of the energy component of the product is not significant compared to the value of its capacity component and as long as impacts on other stakeholders are limited and accepted, this transfer of energy can be resolved in a pragmatic way to facilitate DSR participation in reserve capacity markets. For instance, frequency containment reserves with symmetric activations are reserve products with a high capacity value that can have a minor energy component. In such cases, a simple model with no correction of the BRP source perimeter can have value from a cost-benefit perspective.

Such a market design, characterised by non-correction of the balancing perimeter of the BRP source during the activation period, implies that the BRP source is compensated for the DSR activated energy at the imbalance price. The financial impact for BRP source, either positive or negative, needs to be limited. Such a solution makes sense if the benefits in terms of simplicity outweigh the potential benefits of a more precise solution and are accepted as fair by impacted stakeholders.

The principles of DSR participation in reserve capacity markets can actually be extended to all markets based on capacity, for which products are also based on guaranteed availability, provided there are no overlapping commitments in such markets. For instance, to ensure security of supply in a capacity market, DSR can be a resource equivalent to generation as long as there is no double counting on the demand and offer sides.

ABBREVIATIONS

ACER	Agency for the Cooperation of Energy Regulators
AMI	Advanced Metering Technology
BRP	Balance Responsible Party
DSR	Demand Side Response
DSO	Distribution System Operator
ENTSO-E	European Association of Transmission System Operators for Electricity
NC DC	Network Code on Demand Connection
NC EB	Network Code on Electricity Balancing
RES	Renewable Energy Source
R&D	Research and Development
TSO	Transmission System Operator

AUTHORS

ENTSO-E Working Group
Market Design & RES

CONTACT

ENTSO-E AISBL
Avenue de Cortenbergh 100 · 1000 Brussels – Belgium
Tel +32 2 741 09 50 · Fax +32 2 741 09 51
info@entsoe.eu · www.entsoe.eu