Demand-Side Flexibility

Evolution of Electricity markets in Europe - 2023
Florence School of Regulation
Mastery Challenge

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Abstract

This paper explores how Europe's increasing use of Demand-Side Flexibility (DSF) can help balance its power grid, especially with the growth of intermittent renewable energy. We lay down the main barriers to scaling DSF, discuss the solution space available to regulators and share thoughts on recent, but draft Network Code from EU DSO & ENTSO-E about demand response, underlining the importance of a cohesive European strategy.

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1. Introduction

In 2019 the European Commission (EC) launched its Green Deal: a package of policy initiatives aimed at fostering a green transition within the European Union (EU), with the ultimate goal of reaching climate neutrality by 2050 [1] and being the first continent in the world to do so [2]. As an intermediate step, under the European Climate Law, the EU committed itself to reduce its net greenhouse gas emissions by at least 55% by 2030. With the 'Fit for 55' package, the EC brought the EU policies into line with this target [3].

This transition entails a shift from fossil-fueled power stations, towards largely intermittent renewable energy sources (RES). By as early as 2030 the proportion of intermittent RES of installed capacity in Europe is expected to reach 60% (Figure 1) whilst at the same time, demand for electricity is set to increase due to decarbonization and electrification throughout various sectors. Electricity use across Europe is expected to increase from 2,900 TWh in 2021 to 3,700 TWh in 2030 [4].

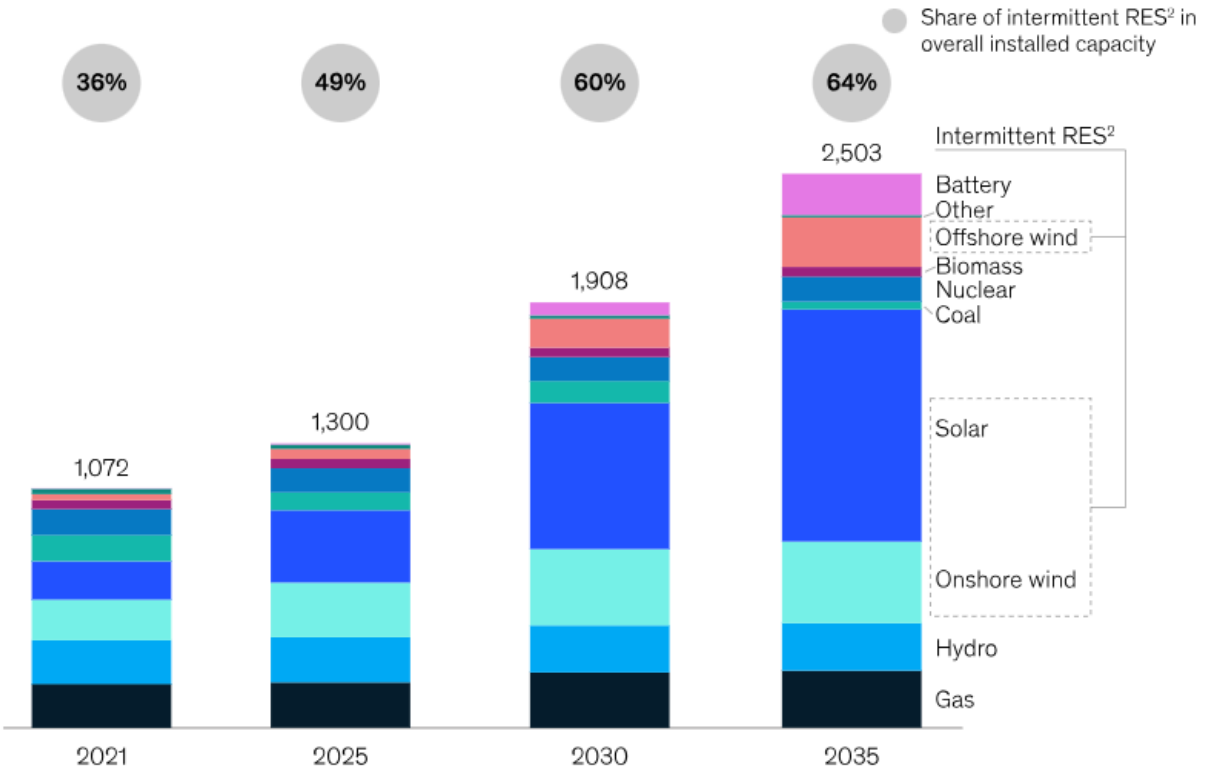

Figure 1: Installed capacity in main European markets under accelerated energy transition, gigawatts[4].

To address the inherent variability of RES and ensure the EU power system reliably handles fluctuating energy supply and demand, the system's flexibility must double by 2030. (Figure 2)[5].

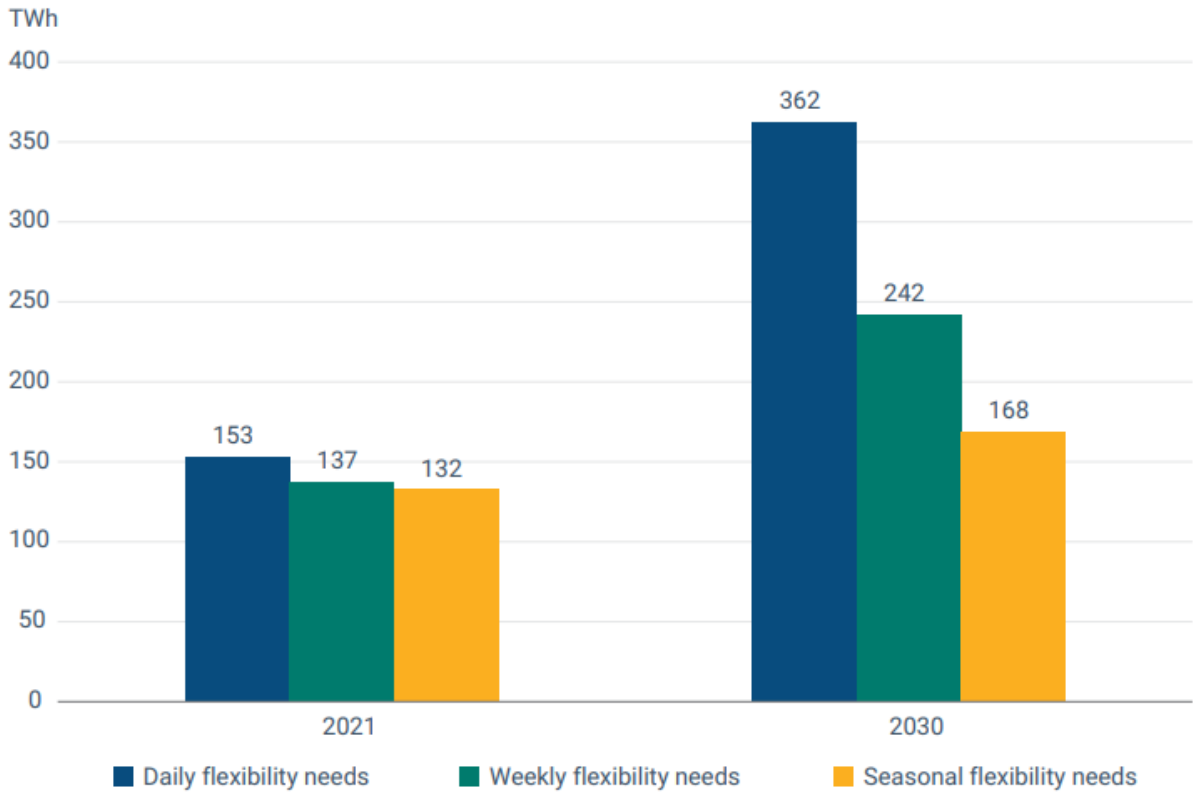

Figure 2: daily (e.g. morning and evening demand peaks), weekly (e.g wind pattern fluctuations) and seasonal (e.g heating-cooling periods) flexibility needs in 2021 and 2030 in Europe, TWh [5].

Demand-side flexibility (DSF) provided by active customers in response to market signals [6], can become a primary source of flexibility.
To illustrate: demand savings in the winter of 2022/2023 led to a reduction of 12% in seasonal, 9% in weekly and 7% in daily flexibility needs [5]. DSF could be integrated and accessed through a myriad of existing products and markets like congestion management (for both TSO's & DSO's), intraday optimization for BRPs and balancing by the TSOs (Figure 3).

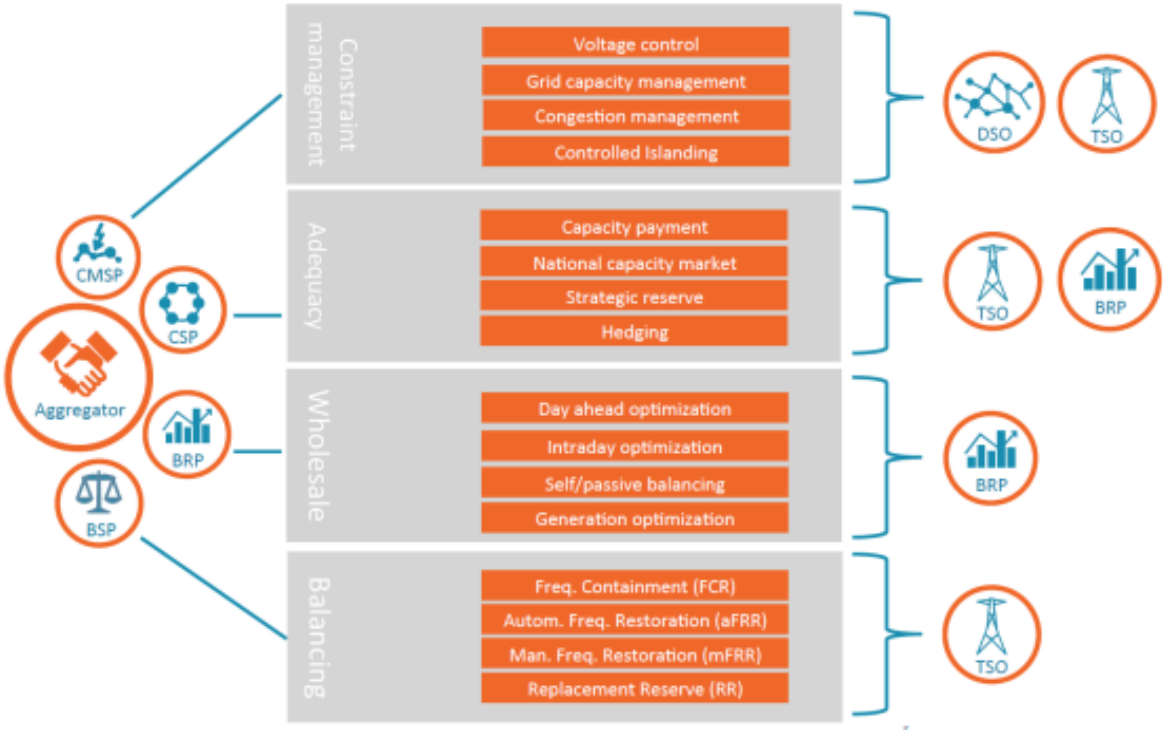

Figure 3: Organized markets and products structured for DSF [7].

The potential socio-economic benefit of DSF is enormous. If the full activation of flexibility from buildings, electric vehicles, and industry is unlocked, DSF is projected to lead to annual savings of:

- €11.1B - €29.1B in distribution grid investments;
- €2.7B in avoided peak generation capacity;
- 15.5 TWh or 61% avoided renewable curtailment;
- 37.5 million tonnes in greenhouse gas emissions; and
- €71B by consumers directly [8].

In this paper, the main barriers to the implementation of DSF are identified and several solutions to overcome these barriers are presented (Section 2). In addition, a concise evaluation of the recently published EUDSO Entity and ENTSO-E draft proposal for a Network Code on Demand Response [9] and recommendations are provided (paragraph 3).

2. Unlock the potential of DSF

Traditionally, to meet consumers' growing demand for electricity, high levels of capital investment (CAPEX) were required to strengthen and expand the grid. As renewable energy sources become more prevalent and society becomes more digital and electrified, the EU Electricity Directive[1] has introduced specific regulations that encourage system operators (SOs) to impartially facilitate the acquisition of DSF services through market-driven methods. This is aimed at optimizing grid operations and postponing or avoiding the need for new infrastructure investments.

Although progress is being made in several Member States [6], there are still numerous legal, technical, economic and informational barriers to activating DSF at a larger scale [5]. This section lists the most important barriers and provides several solutions.

2.1 Main barriers

Listed below are what are considered the main barriers to DSF. Please note: these are general observations and may not apply to all Member States to the same extent [6].

1) **The market-based procurement of all Decentralised Energy Resources (DER) by System Operators is underdeveloped.**
    a) There is a lack of guidelines or procurement clauses to assist SOs in ensuring a fair tendering procedure for energy storage facilities.
    b) Some SOs do not consider DER as an alternative to network expansion in their Ten Year Network Development Plans (TYNDP).
2) **Widespread and persisting limits to the non-discriminatory participation of all DER in all markets and mechanisms are still present.**
    a) A high bid size of 1 MW in several Member States, instead of 500 kW or less as prescribed by the Energy Regulation[2], prevents DER from participating in electricity markets.
    b) Limited access of DER to several market timeframes is observed (i.e. day-ahead, intraday, balancing, but also redispatch). Although the Electricity Regulation[3] provides a clear set of rules for the integration of DER in these timeframes, most Member States fail to comply with these rules.
    c) The lack of a legal framework for independent aggregators prevents them from participating in balancing markets.
3) **A lack of frameworks for innovative services.**
    a) Prior consent by suppliers needed for final customers to be able to purchase electricity services independently.

[1] Directive (EU) 2019/944.
[2] Article 8(3) of Regulation (EU) 2019/943.
[3] Regulation (EU) 2019/943.

b) Suppliers discriminate against customers that have a contract with an aggregator.
c) No free access to end-consumer data by eligible parties, based on consumer's consent.
d) Double network charges for active customers, owning an energy storage facility, which discourages them from interacting with the electricity market.
e) Double taxation constitutes a barrier to 'prosumer' business models

4) **Limited access to price signals for end-users.**
a) The progress of the roll-out of smart meters is lagging in several Member States.
b) A very limited implementation of time-differentiated network tariffs to better reflect the use of the network is observed across the Member States.
c) In several Member States dynamic electricity price contracts are not provided, although these contracts can help optimise the use of electricity, and empower consumers, while increasing efficiency.

2.2 Solutions

As highlighted in the preceding section, practical implementation of DSF is still ongoing owing to several challenges. We believe that the following set of no-regret solutions have the potential to unlock significant and substantial opportunities discussed in Section 1 for DSF:

1) SOs should fully consider the potential of utilising all DER as an alternative to expanding the power grid in their TYNDP.

2) Large-scale installation of smart meters that can seamlessly work with energy management systems and smart grids is carried out. Ideally, these meters will be high-resolution, capable of identifying individual appliance-level consumption, enabling customers to take proactive measures.

3) The issue of aggregators facing discrimination from suppliers is tackled by granting third-party aggregators access to customer-consented smart meter data without any charges.

4) To promote fair access to the market, rules governing DER participation should be technology-neutral. For intraday and day-ahead markets, the minimum participation threshold should be reduced to below 500 kW, and DERs should be eligible for market-based re-dispatching.

5) Implement cost-reflective network tariffs that do not impose double taxation on customer-sited energy storage systems. Move away from fixed volumetric rates and instead adopt dynamic rate plans that vary based on the time of electricity usage. Equally important is educating customers about the financial and environmental impact of modifying their behaviors.

When it comes to the design of congestion management markets at the distribution level there are a range of solutions possible across 5 key market design features, as defined by the European Commission report on Regulatory priorities for enabling DSF [10]. Figure 4 breaks down the solution options for DSF from least integrated on the left to the most integrated

approach on the right with regards to harmonization at the EU level as well as the level of coordination between TSOs and DSOs. The hardest to implement solution politically and technically speaking calls for a creation of a joint market clearing platform that incorporates all grid constraints and assigns price signals (Locational Marginal Prices) to distribution level buses thereby integrating DSF in all market sequences pertaining to day-head, intraday and balancing markets. On the other end of the solution spectrum, DSF product requirements can be independently defined by every DSO based on local needs and a separate congestion management market is added to the current market sequence. Finally, there can be an in-between option that attempts to bridge the gaps. From the perspective of profitable operation and scalable adoption of new demand side resources, the most integrated approach will lead to the best outcomes.

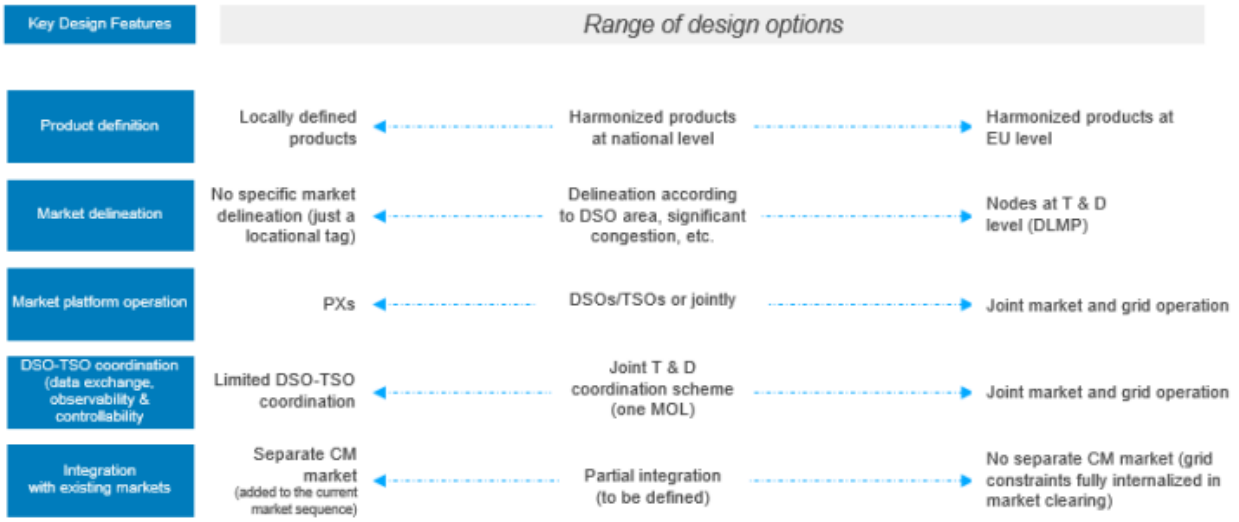

Figure 4: Key design features for Congestion Management at Distribution level [10].

3. The NC DR proposal and recommendations

Based on Article 59(9) of the Electricity Regulation[4]; on 9th March 2023 the EU Commission invited DSO Entity and ENTSO-E to submit a proposal to ACER for the network code Demand Response in accordance with the framework guidelines issued by ACER itself [9]. DSO Entity and ENTSO-E published their draft proposal ('NC DR Proposal') for public consultation from 29 September to 10 November 2023. For the purpose of this paper, the focus will be on the last legislative step undertaken, i.e., the NC DR Proposal.

3.1 The response of NC DR Proposal to the main barriers

In consideration of the main barriers to DSF outlined in Section 2.1, the high-level proposals of DSO Entity and ENTSO-E are enclosed herein:

[4] Regulation (EU) 2019/943.

First, the **level of harmonisation** proposed is rather moderate. The NC DR Proposal sets out a market design that would still be subject to several terms and conditions (T&Cs) to be developed nationally by the SOs, following a public consultation, and to be approved by NRAs (e.g., T&Cs for service providers, SO coordination, market design for congestion management (CM) and voltage control (VC)). Nevertheless, the Proposal sets out some principles and requirements that must be respected and might allow some degree of harmonisation among Member States.

Second, regarding the underdevelopment of '**market-based procurement of all Decentralised Energy Resources (DER) by System Operators',** the proposal sets as a principle that the procurement of services for CM and VC within a bidding zone shall be in accordance with transparent, non-discriminatory and market-based procedures, unless conditions in Article 32(1) and 40(5) of the Electricity Directive[5] apply (i.e., economically not efficient, risks of market distortions, higher congestion, etc.; Article 47). The proposal also sets roles and requirements for procuring SOs and for local market operators (which can be TSO(s)/DSO(s)/third party) (Articles 54-57). Nevertheless, SOs remain free (if transparent and coordinated) to choose between grid investments, non-firm connection agreements, grid-technical measures, including non-costly remedial actions, and market-based procurement and activation of local systems operators' services or other tools to maintain active energy flows or voltage within operational limits (Article 47).

In addition, according to the NC DR Proposal, the procurement of CM and VC should follow listed principles that may address, to some extent, the lack of framework for **innovative**, **efficient, and competitive services**, such as:

- Procurement of products can be contracted in advance in organised markets or tender procedures;
- Submission of bids from non-precontracted providers in capacity markets shall be allowed;
- Allow for reusing non-selected bids under service provider consent;
- Final customers must have the right to choose the service provider and technical aggregator for their controllable units and must be able to change service provider at any time;
- Where applicable, day-ahead, intraday or balancing products could be part of the list of standardised products for congestion management (Article 60).

Third, in respect of ensuring the **non-discriminatory participation of all DER**, the NC DR Proposal provides different set of rules, such as:

- TSOs to develop proposals for a roadmap for the implementation allowing to set the bid granularity of all standard balancing products at one decimal starting from the minimum bid size of standard balancing products (Article 29);

[5] Directive (EU) 2019/944.

- Principles, requirements and procedures for flexibility register platforms[6] (e.g. common front door, interoperability, minimum requirements for data, access, information, application etc.) (Articles 39-44);
- National T&Cs are to be adopted to harmonise market access (simplify access, avoid duplication etc.) as well as national and EU tables of equivalence ('ToEq') to facilitate product prequalification for units participating in multiple markets (Article 46).

Finally, regarding **access to price signals for end-users**, the NC DR Proposal does not seem to address this issue directly. Per the draft, allocating and recuperating operational expenses (OPEX) through congestion management or recovering capital expenses (CAPEX) resulting from network investments significantly influences the determination of customer tariffs and affects the regional distribution of prices within a Member State. The responsibility for deciding how these costs are apportioned and reclaimed from customers, as well as the role of transmission and distribution system operators in conveying location-specific price indications to customers, lies with national authorities. Also, although the NC DR Proposal does not provide any specific provision related to the roll-out of smart meters, it should incentivise the latter because it is clear from the Proposal that there is no procurement of DSF services without the collection and processing of meter data.

3.2 Recommendations

In 2019 an expert group of the European Smart Grids Task Force (ESGTF) stated that the technical and operational aspects of DSF are not harmonised across the EU, and, consequently, that there is a lack of interoperability between different devices, platforms, and systems that enable DSF. This limits the scalability, efficiency, and reliability of DSF, and increases the costs and complexity for its implementation [7].

Given that the NC DR Proposal sets out a market design that would still be subject to several T&Cs to be developed nationally by the SOs, there is a real risk that the level of harmonisation across the EU will not be sufficient to overcome the problems mentioned by the ESGTF. Moreover, the more space is granted for T&Cs to be developed at national level, the higher the risk will be that Member States deviate from each other and, thus, the harder it will become to reach a harmonised set of rules in the future.

With the overarching goal of EU electricity market integration and the challenges associated with the energy transition in mind, more T&Cs on demand response should be harmonised on a European level. But attention needs to be given to the numerous design choices with regard to DSF that are to be made, especially considering the differences between Member States with regard to, e.g., tariff design and differing balancing strategies. Therefore, we recommend a clearer and more flexible drafting of Article 84 (*Harmonisation*). In its current version, this article

[6] "*'Flexibility Register' means an information system consisting of one or multiple and diverse platforms operated by one or multiple national actors to support the registration and prequalification for the provision of balancing, congestion management and voltage control services.*" (Article 2 (17) of the NC DR Proposal).

allows further EU harmonisation only after “several monitoring reports” (issued every 3 years). We recommend a clearer wording, allowing EU harmonisation on a specific area after one monitoring report. Furthermore, EU harmonisation is allowed only on listed areas (eg. product verification processes and product prequalification processes). Additional areas can be subject to harmonisation after a proposal developed jointly by ENTSO-E and EU DSO Entity and submitted to ACER for review and approval, and following a public consultation. We recommend simplifying this lengthy process to facilitate EU harmonisation initiatives everytime it increases overall effectiveness and efficiency of the system (along with a supporting costs analysis).

To ensure the future viability of the wholesale market alongside active distribution system management, it is crucial to work on coordinating national systems. Failure to do so could result in strong lock-in effects, making it challenging to achieve a future-proof wholesale market in conjunction with active distribution management. These recommendations are in line with the observations made in the European Commission report on Regulatory priorities for enabling Demand Side Flexibility [10].

References

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