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CEER Advice on Ensuring Market and Regulatory Arrangements help deliver Demand-Side Flexibility

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INFORMATION PAGE

Abstract

In 2013, the Council of European Energy Regulators' (CEER) Sustainable Development Task Force (SDE TF) committed to produce a report exploring the emergence of demand-side flexibility (DSF) within the regulated electricity sector. Demand-side flexibility has the potential to offer a range of benefits, such as reduced system/consumption costs, enhanced generation adequacy and greater accommodation of intermittent renewable energy sources (RES). **However, appropriate market and regulatory arrangements must be in place before this potential can be realised.**

This paper, together with its companion annexes and consultation document, sets out the background, definitions, opportunities and barriers associated with the emergence of DSF. It concludes by offering a series of high level principles which regulators consider should govern how DSF operates as well as a number of short to medium term recommendations for regulators and other interested parties to take forward.

This CEER Advice supports regulators' further work in this area within CEER, ACER and the European Commission's Smart Grids Task Force, which in turn will help inform wider developments in European energy policy and ensure the market and regulatory arrangements help deliver demand-side flexibility.

Target Audience

European Commission, National Regulatory Authorities (NRAs), Transmission System Operators (TSOs), Distribution System Operators (DSOs), energy suppliers and generators (of all sizes), traders, aggregators, energy customers, energy industry, consumer representative groups, network operator representative bodies (e.g. ENTSO-E), Member States, academics and other interested parties.

Keywords

Demand-side flexibility; markets; networks; aggregator; tariffs; consumers; smart meters

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EXECUTIVE SUMMARY

Background

The Energy Efficiency Directive 2012/27/EU (EED) entered into force on 4 December 2012 and most of its provisions must be implemented by EU Member States (MS) before 5 June 2014. Article 15 of the EED addresses demand response, explicitly the role of National Regulatory Authorities (NRAs) in encouraging demand response to participate in wholesale and retail markets (including balancing and ancillary services markets).

To assist NRAs' understanding and implementation of the provisions of the EED, CEER started work on this topic in 2013 with an internal survey among NRAs and a public consultation. The goal of this work is to provide best practice examples (drawn out in the public consultation paper's case studies) and also to draw out some key principles and specific recommendations in the form of this advice paper.

Main Objective

This advice paper is designed as input to advance the ongoing discussion about the scope, players and benefits of demand-side flexibility from both a network and market perspective. This work is part of an ongoing process that should contribute to assistance for NRAs and MS on how to encourage the participation of demand-side resources in their markets and networks.

It also sets out regulators' views on the high-level principles which should govern demand-side flexibility and allow it to be facilitated at the wholesale, network and retail levels**.**

Conclusions

As a high-level outcome, CEER wants to **unlock the value of demand-side flexibility for the provider/customer**. This requires:

- That consumers and market participants have the necessary information and tools to adequately and effectively engage in the market;
- A market free from barriers that promotes equal access for all parties and new entrants, through interoperable standards and arrangements; and
- A regulatory framework that is flexible enough to adapt in an evolving market.

1 Introduction

In the Energy Efficiency Directive, EED (2012/27/EU), European energy regulators are given an explicit role for encouraging demand response participation in wholesale and retail markets.

Article 15(8) of the EED states:

"***…national regulatory authorities [should] 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 ensure that transmission system operators and distribution system operators****, in meeting requirements for balancing and ancillary services,* ***treat demand response providers, including aggregators, in a non-discriminatory manner, on the basis of their technical capabilities***".

Demand-side flexibility (DSF) has the potential to provide significant and multiple benefits: to enhance network security, to increase competition in markets, to aid industrial competitiveness, to minimise the need for investment, and, ultimately, to benefit customers. However, the realisation of DSF, at least in part, relies on the market and regulatory arrangements which exist. As custodians of these arrangements, **regulators therefore have a role in facilitating DSF, as well as a direct responsibility under the EED**.

It is for this reason that regulators in the Council of European Energy Regulators (CEER) have assessed the current state of play and formulated this advice. **The advice is addressed to both policy makers and the regulators themselves.** In particular, it will act as an umbrella set of principles which will guide regulators as they drill down into specific aspects of DSF in the coming years.

1.1 Process to date

Originally conceived as a response to the NRA-specific obligations in the EED, this paper has subsequently broadened its scope to consider the wider market and regulatory arrangements necessary for DSF to emerge and participate/compete alongside other forms of flexible capacity (generation, storage, interconnection) on a level playing field.

The work began in 2013 with an internal survey of CEER member NRAs on the status of DSF in their countries (see Annex 3), followed by a 6-week public consultation in November/December 2013 and a stakeholder workshop at CEER, Brussels, on 18 November 2013[1].

This document is the culmination of that work and **sets out regulators' views on the high-level principles which should govern DSF and allow it to be facilitated at the wholesale, network and retail levels.**

[1] Further details of the public consultation and workshop can be found on the CEER website here.

The report, prepared by CEER's Sustainable Development Task Force, represents the first piece in the jigsaw of CEER's work in this area. In late 2014 CEER will bring forward a Green Paper on the 'Role of the DSO' followed in 2015 by a customer-orientated Benchmarking Study on Demand-Side Response and Energy Efficiency.

This paper is also related to the ACER paper and public consultation on "Energy Regulation: A Bridge to 2025" on the likely changes and necessary regulatory responses to the critical 2014 – 2025 period.

NRAs are also contributing to the wider work on flexibility as part of the European Commission's Smart Grids Task Force (EG3)[2].

1.2 Structure

The document is divided into five main sections:

- CEER definition and explanation of Demand-Side Flexibility
- Potential benefits of DSF
- Potential barriers to DSF (as viewed by stakeholders)
- Future developments
- Conclusions (key principles and specific measures to enable DSF)

1.3 Consumer Perspective

CEER regards customer participation in the electricity market as extremely important, and realising the potential of demand-side flexibility offers an important route to increasing that participation. In particular, CEER views the restoring and building of consumer trust in energy markets as key, and in 2012 launched its joint statement (in conjunction with BEUC, the European Consumers Organisation) on its **2020 Vision for Europe's Energy Customers[3].**

In this context, **DSF** – if enabled to compete on a level playing field with other measures such as interconnection and electricity storage – **has the potential to bring significant benefits to consumers (including 'prosumers'), from both an *engagement/ empowerment* (over their own energy use and ability to control bill impacts) and *avoided/deferred investment (*a more flexible grid may defer investment in new generating capacity) *perspective*.**

CEER calls for the interests of all consumers to be a key consideration during formulation of future DSF policies at national and European level.

[2] http://ec.europa.eu/energy/gas_electricity/smartgrids/taskforce_en.htm

[3] http://www.ceer.eu/portal/page/portal/EER_HOME/EER_PUBLICATIONS/CEER_PAPERS/Customers/Tab3/CEER-BEUC%202020%20VISION-joint%20statement_Long_v03062014.pdf

1.4 Next steps

Work on DSF remains an ongoing process and this advice paper is to be seen as part of a European effort to better understand the scope and needs of the different players engaged in DSF, as well as identifying the underlying benefits and the possible barriers to its emergence. CEER will keep working on the topic to deepen its knowledge about the different aspects of DSF and inform regulatory policy at a national and European level.

2 CEER definition and explanation of demand-side flexibility

Key points:

- **Demand-side flexibility is the capacity to change electricity use in response to a signal that can be price-based or a contractual arrangement**
- **DSF has the potential to provide value throughout the energy system (markets and networks)**
- **The relationships between reducing/increasing peak/off-peak demand and system balancing are fluid, but crucially DSF can also be used to increase demand when that is desirable for an increasingly unpredictable generation portfolio and balancing (frequency control)**

2.1 CEER definition

CEER's definition[4] of demand-side flexibility seeks to distinguish DSF or demand response, from demand-side participation, demand-side bidding, or flexibility in a wider sense, as well as energy efficiency (entailing a permanent demand reduction). Further detail and exploration of this definition can be found in the consultation document which can be read as a companion to this paper. The CEER definition of DSF states:

*"**Demand-side flexibility** can be defined as **the capacity to change electricity usage by end-use customers** (including residential) from their normal or current consumption patterns **in response to market signals**, such as time-variable electricity prices or incentive payments, **or in response to acceptance of the consumer's bid**, alone or through aggregation, **to sell demand reduction/increase** at a price in organised electricity markets or **for internal portfolio optimisation**.*

*__The objective__ of such market signals is **to induce modulation** (increase[5] or reduction) of electricity usage **and to optimise usage and balancing of networks and electricity production and consumption**, for example by consuming less during peak times or by facilitating the integration of increasing electricity generation from variable renewable energy sources and micro-generation."*

This definition acknowledges that **DSF can be the result of a wide range of signals**, from price-based time-of-use tariffs or critical peak pricing to contractual-based direct load control (which may be automated). In the space between these signalling methods, a wide range of DSF can be used by varied actors, explored further in Chapter 3.

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[4] Builds on an earlier CEER definition: "*Changes in electric usage by end-use customers/micro generators from their current/ normal consumption/injection patterns in response to changes in the price of electricity over time, or to incentive payments designed to adjust electricity usage at times of high wholesale market prices or when system reliability is jeopardised. This change in electricity usage can impact the spot market prices directly as well as over time*." [Source: CEER Advice on the take-off of a demand response electricity market with smart meters, 1 December 2011]

[5] An increase in electricity consumption is necessary to provide negative balancing energy and may be desirable when demand is low and negative prices/RES curtailment occurs.

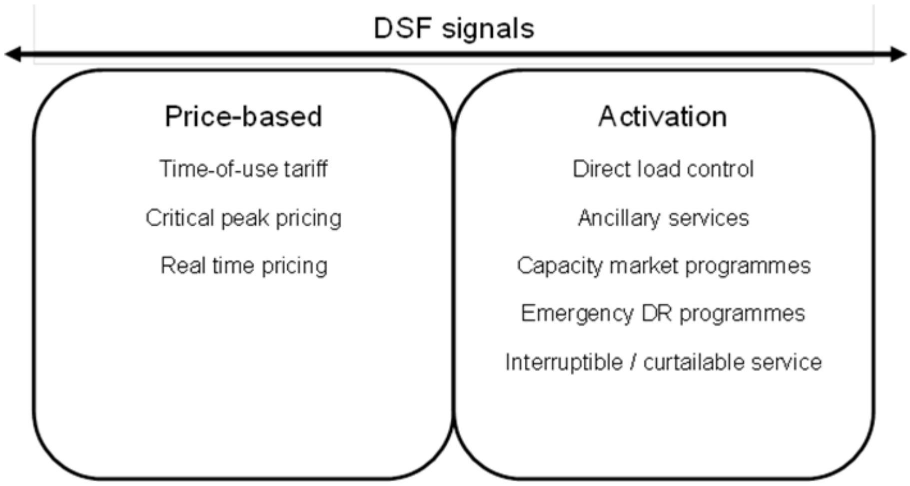

Figure 1: Types of price-based and activation signals [Source: adapted from Potential Implementation of Demand Side Approach Methods in ERRA Countries, ERRA 2009]

As stated in the definition of DSF, **the modulation of the expected consumption pattern can result in a shift, i.e. an increase as well as in a decrease, in electricity usage, without necessarily affecting the overall consumption level.**

While the benefits of the latter are obvious in terms of security of supply (for example during peak periods), the interest in seeking a higher level of consumption during off peak periods may raise some concerns that this could create an artificial 'second peak' or work against the overall European energy efficiency and demand reduction objectives.

There may be a need in certain cases to contain that increase, although under normal circumstances shifting consumption to different times of the day, as a reaction to a signal, might be of interest for the network especially regarding the integration and management of renewable generation peaks, and should therefore allow for this form of DSF.

2.2 Explanation

CEER's definition of DSF involves both sides of that flexibility – i.e. a reduction or an increase in demand. These two sides have to be able to access the market alongside supply. For system balancing, an increase in electricity usage is usually required to provide negative balancing energy, while for the integration of renewables shifting demand to time periods with lower consumption or 'valley filling' might be a solution to prevent temporary feed-in reductions. It could also allow market players to profit from lower wholesale electricity prices (see Figure 3).

DSF encompasses various forms of dynamic changes in energy consumption. These changes have value for various parties throughout the whole energy system (disaggregated into Balancing, Capacity, Generation and Networks services and described in Figure 2 below). In the Networks box, we can include voltage control, reactive power and load management.

To better understand the value and motivations of different players to engage with DSF, an artificial distinction can be made between DSF for market purposes and network purposes.

- DSF for market purposes includes any demand side flexibility triggered through market signals that balances out the system, ensures adequate generation capacities or reduces overall generation costs.
- DSF for network purposes can be as an alternative or substitute for network assets.

In practice however, the delineation between DSF for market and networks purposes is not always straightforward as the response for network purposes may also contribute benefits for market participants, and indeed market signals/competition is also possible in the network segment of the regulated energy market.

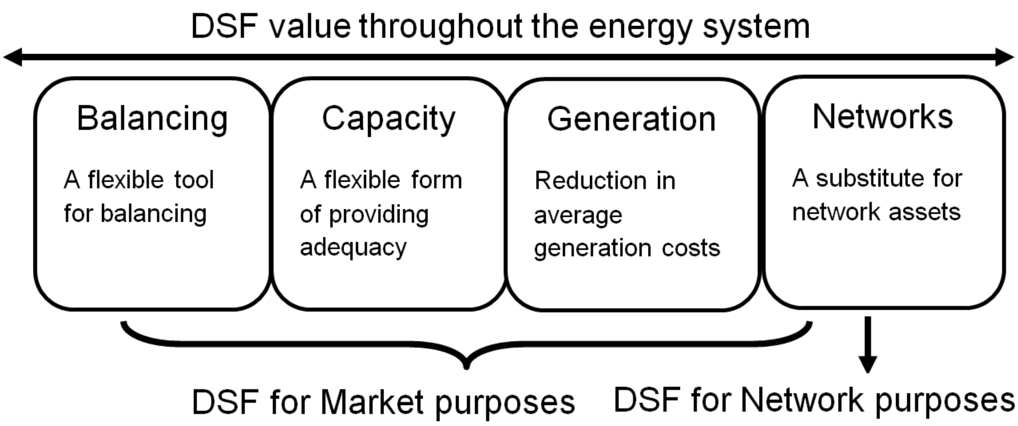

Figure 2: Use of DSF across the electricity system [Source: adapted from Creating the Right Environment for Demand-Side Response, Ofgem 2013]

<u>DSF for market purposes</u>

The main opportunities for DSF in the market lie in its potential for valley filling, peak shifting and balancing as shown in Figure 3. In terms of peak shifting and valley filling these may occur independently of each other, though there may often be a 'mirrored effect'. **This dual aspect of DSF allowing demand to increase (valley filling) as well as decrease (peak shifting) is important to highlight.**

It is also important to note that regardless of the parties involved in these actions **it is the overall outcome which is of primary importance, i.e. improved system efficiency, generation adequacy, increased penetration of intermittent RES generation, and deferred or avoided network investment.** It is also the case that in some MS negative prices are not allowed so RES must be curtailed in some circumstances.

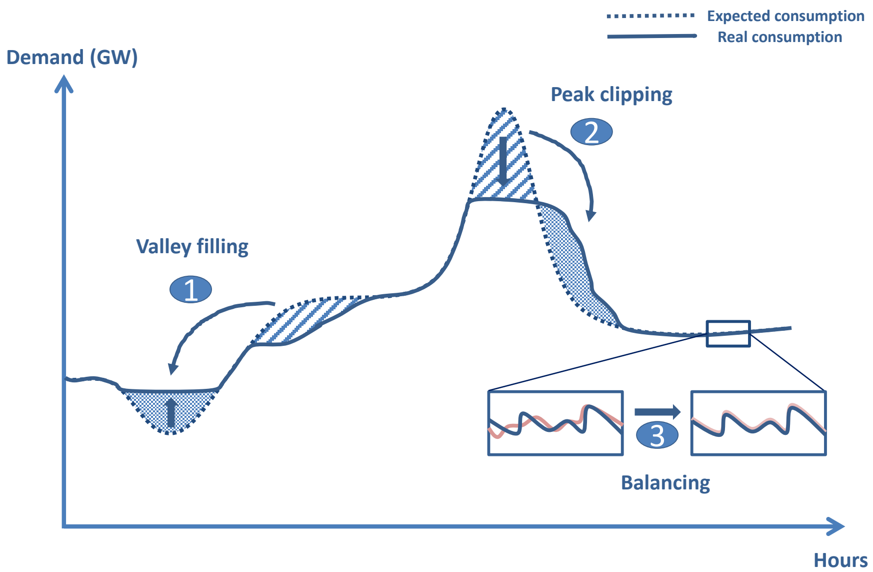

Figure 3: Market-led DSF illustration [Source: adapted from CRE internal document]

DSF for network purposes

In terms of the benefits of DSF as a substitute for network assets, further research is needed to quantify these. Indeed, both the quantitative value of DSF and mechanisms to trigger this kind of flexibility lack practical and theoretical investigation. However an enduring reduction of 2MW in peak load demand as a result of DSF measures should, in theory, mean 2MW less capacity required on the network with the potential for reduced investment in network infrastructure in the long term. It is likely that the market and network benefits of DSF are complementary and not competing.

Cost and availability of DSF

The following graph (Figure 4) illustrates the main categories of DSF that can be identified while assessing the different realities in terms of costs and availability of the resource[6]. For example, residential DSF will usually require significant capital costs to gather small amounts of flexibility from thousands of consumers, but will probably cost very little to operate once deployed.

Conversely, large industrial consumers will often be able to provide a significant amount of flexibility (up to hundreds of MWs) with low capital costs, but will in contrast require very high operational costs because of the higher value of the curtailed energy and the impact on the industrial process. Due to the impact on the industrial process and associated costs (resulting from a change in the consumption pattern of the site) it could be that in certain cases DSF would not be profitable and therefore not implemented.

[6] The graph was prepared by the French national regulatory authority, CRE, drawing out a schematic of DSF types and characteristics. It does not represent all potential DSF technologies nor the reality in all European countries, but it does give a good overview of possible DSF categories and their intrinsic characteristics.

Aside from the cost of activation, another key element that has to be assessed when conducting a cost-benefit analysis (CBA) for DSF is the availability of the resource. As with generation units, the different DSF capacities will be able to provide different ranges of availability, from only a few to several hundred hours a year. Reaction times, especially in balancing markets, are another key element.

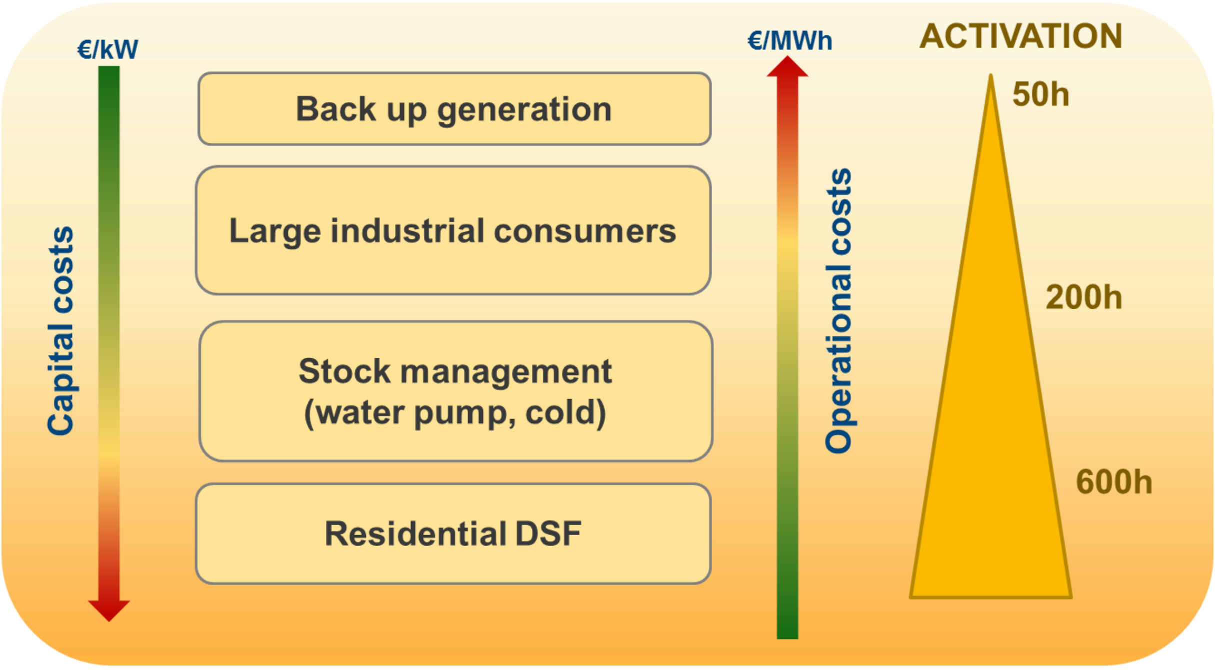

Figure 4: Simplified Representation of Demand-Side Flexibility [Source: adapted from CRE internal document[7]]

The following text provides some further explanation of the component parts in Figure 4:

Back up generation ('grey DSF'): some industrial sites have their own back-up generation units, usually small fuel generators that are able to provide power to the site in case of emergency situations. This is sometimes referred to as 'behind the meter' generation or 'grey DSF', and is distinct from 'green DSF' which is the result of a genuine turn down and shifting of consumption on the network. As these back-up generation units have typically been put in place for security reasons, the consumer does not have to bear any capital costs to run the units in other situations and to value the flexibility they provide. However, those units are usually very expensive to run and will only be used if the prices go over 200-300 €/MWh or even higher, which implies (just as for generation peak units on the network) a low number of running hours.

Large industrial consumers: DSF provided by industrial consumers (when it interrupts a production process) can also have very high operational costs due to the possible disturbance to the industrial process caused by the temporary stop. In contrast to back up generation units, industrial consumers usually have to bear additional investment costs (even though limited) to put this flexibility into place (special telecom process etc.).

[7] See footnote 6, page 11.

Stock management: this specific kind of flexibility can be provided by industrial consumers that use processes with high inertia which can be moved easily according to market opportunities. For example, water treatment stations or cold storage units will be able to modulate their consumption while keeping the same level of production overall and therefore encounter no loss of value. This kind of flexibility is therefore usually less expensive to run, but it can also require higher capital costs because of the higher technological requirements to assess the flexibility potential and to plot the consumption level accurately.

Residential DSF: this flexibility usually requires gathering the potential of a large amount of small consumers in order to achieve a minimum size, which requires higher capital costs (though these are mostly for communications and IT systems, and have to be borne entirely by the residential consumers). Once the capacity is available it can be activated at minimal operational costs (no loss of industrial production, very few variable costs in general) and repeated almost every time market conditions present opportunities (dependent on pool size, application, and duration). However, the end-user's level of comfort can limit the overall amount of flexibility he/she will be willing to provide.

From another perspective, when conducting a CBA analysis, the benefits of DSF depend significantly on the characteristics of the market; in other words, no intrinsic value of DSF can be measured. Market mechanisms have to be designed so not only the technical but also the economic barriers to the full participation of DSF are levered in order to reflect the full value DSF can bring to the electricity system.

3 Potential benefits of Demand-Side Flexibility

Key points:

- **There is widespread agreement on the potential for Demand-Side Flexibility to benefit the energy system as a whole, for example by contributing to generation adequacy, increased RES penetration, and reduced balancing costs**
- **The costs and benefits of DSF are uniquely difficult to quantify at a macro level, however numerous studies have demonstrated its potential**
- **When assessing the environmental benefits of DSF, it is important to factor in the distinction between back-up generation ('grey DSF') and genuine load shifting as a result of turn down/ramp up on the network ('green DSF')**

The following section sets out the potential benefits of DSF including some of the benefits highlighted by stakeholders in our public consultation. Most of these responses recognised that DSF has great potential to benefit consumers and other actors, as well as the system as a whole.

Market integration of RES: DSF can be an important tool to handle the increasing shares of intermittent generation in the electricity system. Balancing the network not only from the supply side but also from the demand side is a growing necessity when considering increasing penetration of renewable energy (RES) feed-in.

Looking at the overall costs for the system, DSF can result in reduced investments in generation capacity, thus reducing system costs. Under certain conditions, DSF can therefore be cheaper and available more quickly than additional generation capacity.

Benefits for consumers: when it comes to the current benefits for consumers it is reasonable to state that it is mainly industrial consumers that benefit from DSF. Current arrangements for DSF make it much more attractive for large consumers with higher electricity consumption (and higher costs per MW) than for domestic households. It is therefore more likely that larger industrial or commercial consumers will engage with DSF to create an additional income stream by selling flexibility and reducing their energy costs, or mitigating against cost increases.

A major benefit for consumers is that whenever DSF participates in the market it can help to substitute peaking power plants, thus reducing peak prices which in turn can be passed on to consumers via lower energy bills. The wider system benefits leading on from this include a real contribution to the Internal Energy Market and greater integration of renewables.

Given the proportion of total demand that is made up of residential consumers across the EU, it is likely that following the roll-out of smart meters there are potential benefits from capturing the value of residential DSF[8].

[8] Further assessment of the potential benefits and the enabling market features (or lack thereof) will be necessary.

Environmental benefits: there are also potential environmental benefits[9] to DSF. When it is fully integrated in the market, society as a whole may be able to cover its energy needs with less installed generation capacity. This results in more resource efficiency and in a reduction of CO_2 emissions, as current peak units do not have to ramp up and curtailment of non-programmable RES (i.e. wind, solar) can be avoided.

Benefits for competition and innovation: finally, DSF can contribute to a more competitive and innovative environment by enabling new actors to enter the market with new business models, services and products (e.g. smart appliances). The number of participants in the energy market is likely to grow as a result of more demand-side flexibility, which in turn can lead to greater market liquidity and competition (especially in balancing markets).

Achieving the full potential of DSF will require a market design that rewards the provider of the flexibility for the benefits it brings. **The following table (Figure 5) sums up the main benefits of DSF that have been identified, and the mechanism to provide a proper remuneration to the provider of the flexibility.** Some respondents to our consultation stressed that as of today the incentives that consumers were receiving to adjust their consumption did not reflect the value that it could bring to the system (during peak periods for instance).

Potential benefits	Details	Valuation (where DSF service/product engages)
Improved long-term security of supply	• Avoided investment in peak generation units • Back up for intermittent generation	• Participation in capacity remuneration mechanisms
Improved short-term security of supply	• Additional flexibility, reduction of balancing costs	• Participation in balancing reserves (capacity + energy remuneration)
Reduced market price	• Production cost savings • Lower spot prices	• Spot price
Reduced network costs	• Reduction of losses recovery costs • Avoided investment costs	• Reduced network tariffs • Difficult to assess the value at this stage
Better integration of renewables	• Increased flexibility to manage renewables intermittency	• Cheaper balancing reserves • Wholesale market (negative prices/RES curtailment)
Environmental benefits and energy savings	• Potential reduction of global CO_2 emissions • If deferment is less than 100%	• EU ETS dedicated mechanism • Dedicated mechanisms (white certificates, direct subsidies programme)
Social and economic benefits	• Reduction of fossil fuel import dependency • Industrial competitiveness • Jobs and innovation	• Risk covered in the pricing of fossil generation • No direct link with DSF action • Net jobs creation

Figure 5: Potential benefits of Demand-Side Flexibility [Source: adapted from CRE internal document]

[9] Unpublished studies indicate that local environmental benefits may be affected by the use of diesel generators to provide demand-side flexibility.

Figure 5 illustrates that the main benefits from DSF (as identified by respondents to the public consultation) can be valued by market mechanisms that are already in place, suggesting that the EED recommendations in this respect have been met. The key question is whether the opportunity exists for DSF to participate in those mechanisms or not, as well as the effectiveness of the mechanisms. Given that the mechanisms are in place, the incentives to trigger DSF (and its underlying value) will likely increase going forward. However, the cost of deploying DSF will have to be compared to market signals in order to trigger (or not) additional DSF capacities.

For instance, a market with no 'long term' security of supply issues (i.e. having enough installed capacity to meet peak periods) will probably send very few, if any, signals for additional network capacity to be developed. Yet, if additional flexibility is required on this market, the price of balancing reserves or bids might send a signal for DSF providers to develop additional capacities to sell to the transmission system operator (TSO) on the balancing mechanism. With limited access to the market mechanisms, DSF providers might, however be unable to assess what value additional capacities could gain.

4 Potential Barriers to Demand-Side Flexibility

Key points:

- **Stakeholders hold a varied set of views on barriers to the proper emergence of DSF. CEER acknowledges that some of these may be detrimental to the emergence of DSF across Europe**
- **The emergence of new actors will be a game-changer in terms of engaging consumers (at various levels) and in their relationships with incumbent DSOs and suppliers**
- **In particular, the evolving energy landscape will entail significant changes to how market participants operate, with significant opportunities for DSOs**

The following section sets out some potential barriers to DSF which, following analysis, should allow regulators and policy makers to focus their efforts on creating the necessary conditions for DSF to emerge.

4.1 Potential Barriers identified by stakeholders

These are based on the responses to our consultation and the public workshop. Understandably, different stakeholders view these barriers from different perspectives, either regulatory, legislative, market, or other. Similarly, the extent to which something is perceived as a barrier or not depends on the stakeholder or the situation in their respective national market. A full evaluation of stakeholder responses can be found on the CEER website[10].

For this summary, the barriers identified are grouped under thematic headings: markets, regulatory, pricing/signals, and political, technological & social aspects.

Theme 1 – Market arrangements[11]

- **Market access and transparency:** in some MS, aggregated DSF does not have legal or direct access to the balancing and/or wholesale markets. This can occur where the consumer consents for their load profile to be shared with a third party, but the supplier, Distribution System Operator (DSO) or Balancing Responsible Party (BRP) prevents third parties from accessing this data[12]. It is this data which is necessary to determine if the consumer's consumption pattern suggests the potential for DSF services to be offered. This can prevent new entrants from participating in the market and customers from being rewarded for the value of their flexibility. Other barriers include minimum trading volumes and non-acceptance of aggregated bids.

- **Measurement and verification of DSF:** the determination of the baseline (the level of consumption that would have existed without DSF) is very important. DSF will not be able to compete on a level playing field with supply and other flexibility measures if it cannot be properly measured and certified.

[10] Link to Evaluation of Responses on CEER website

[11] An important caveat is that depending on the system requirements in a MS different approaches may be required to allow DSF to access the market, although proven and unjustified barriers should be removed.

[12] In many MS independent DSF providers need to have the retailer's/BRP's permission (and that of the DSO and TSO) to offer DSF services/products to a consumer giving the retailer/BRP power to discriminate by refusing, charging prohibitive fees, etc.

Theme 2 – Regulatory Framework

- **Lack of an overall framework for DSF:** a coordinated framework may be required to set out what needs to be achieved to realise DSF but leave participants the freedom to determine how to reach that goal. This includes the need for balancing responsibilities to be clearly defined and constantly monitored.

- **Need for clearly defined roles for market participants:** this is clearly an issue which presents stakeholders with difficulties, though there are differing views among them on the exact delineation between roles. The lack of clarity regarding the role of aggregators as well as the relationship between TSOs, DSOs and market operators is problematic.

- **Role of DSOs:** there are different roles for DSOs across the EU which have developed over time. This indicates that a one-size fits all approach as to DSOs' engagement with DSF may not produce efficient outcomes in each MS. Whether or not the DSO is already a market facilitator will likely impact its future role in an evolving energy market. **There should be equal and fair access to DSF markets for all actors in these differing market set-ups.**

  Regulatory preparation for a more actively managed distribution network is necessary. Where DSOs have an advantaged position in terms of access to metering data, it should be examined to what extent allowing a DSO to provide competing services could distort the market.

  Methodologies for how **system states** (which describe the impact of grid and market interactions on the network) are monitored, calculated, audited and controlled may need to be more clearly defined based on the local distribution network characteristics. DSF measures should be taken into account when assessing service quality measures in this context.

- **Unbundling:** the 3rd Energy Package rules are less stringent on DSOs as opposed to TSOs. In those MS where DSOs act as a market facilitator there are legitimate concerns over the information asymmetries between DSOs and suppliers or other third party actors wishing to engage consumers in DSF services/products. There is also a broader question on whether unbundling helps create the right incentives for DSOs to be 'neutral market facilitators' when many now wish to actively participate in the market. These questions will be examined in more detail in a CEER Green Paper on DSOs later in 2014.

Theme 3 – Pricing/Signals

- **Regulation:** consideration needs to be given to how upfront investment in DSF enablers is funded and recovered, and how this cost is treated in the current regulatory framework across the different MS. The increasing role of Smart Grids and Information Communications Technology (ICT) will affect these different regulatory frameworks in different ways.

  Also where DSF affects the load profile this should be factored into network planning. Currently in many countries, network tariffs (including levies and taxes) are set in a way that discourages certain industries from participating in DSF.

- **Current grid** tariff structures could create an unfair allocation of costs among users, especially due to metering constraints which result in users being on the same tariff despite creating different costs. As the number of "prosumers" increase there may be an impact on grid fees.

- **In many countries, DSOs always have to connect network users** without delay and offer the same unlimited access to network capacity at any time. If unlimited access is not possible due to constraints (even if only for a few hours per year). DSOs may have to extend the grid, unless they have a separate DSF arrangement with that customer.

- **Retail price regulation:** this is frequently cited as a fundamental barrier to the emergence of DSF.

Theme 4 – Political, Technological & Social aspects

- **Implementation of legislation:** work on implementing the 3rd Package and EED needs to continue (progress within ACER and the ENTSOs and at national level by NRAs and TSOs as well as in the European Commission's Smart Grids Task Force and in various standardisation bodies is helpful in this regard).

- **Consumers:** there needs to be a shift in policy focus from the potential of technology to actually meeting consumer needs, and the reality of their current engagement with the market. Sometimes even simple tariffs can be difficult for consumers to understand so new DSF tariffs need to tackle this challenge. Access to data is fundamental for DSF, but consumers need to be protected (though regulation on data protection and privacy already exists).

  Consumers should have the same protections and rights when dealing with third party intermediaries as when dealing with traditional retailers, and be able to easily identify trustworthy third party intermediaries. There are additional concerns regarding how the costs and benefits of flexibility will be shared between different consumer segments.

- **Smart Meters/technology:** the roll-out of smart metering for households and commercial customers with the appropriate functionalities remains a significant challenge. Smart Meters are a fundamental enabling factor for DSF, however some of the current generation of smart meters may not be adequate to deliver all services required for DSF and standardisation across Europe remains an issue[13]. In addition, many appliances are not 'smart ready' so without making the feature mandatory, some appliances (e.g. fridges) are unlikely to be available in sufficient numbers to deliver the potential benefits of DSF.

[13] CEER Status Review of Regulatory Aspects of Smart Metering (Including an assessment of roll-out as of 1 January 2013)

5 Future developments

Current market regulations were developed to manage large, reliable load from predominantly thermal generation, and are less well suited to management of intermittent generation or facilitating flexible demand, which means that demand-side flexibility measures can often be under-valued compared to other balancing mechanisms. However, this situation is slowly beginning to change across MS as regulators and market participants react both to the challenges associated with the transition to a low-carbon energy system as well as the associated benefits and opportunities for new business models.

As highlighted consistently by stakeholders, regulated retail prices make realising the value of DSF for residential consumers difficult. In accordance with the 3rd Package, some of those NRAs across Europe which have regulated energy prices have agreed to phase them out over time[14]. In most cases, the phasing out of regulated pricing should improve the accuracy of market signals, which in combination with dynamic pricing will lead to more effective demand-side incentives by allowing consumers and micro generators to benefit from the genuine value of shifted demand and generation.

The increasing emergence of aggregators and other actors suggests that DSF will play an increasing role in the future as a result of growing shares of intermittent RES production in the energy system. This will make planning and management of supply and demand an increasingly complex task. Therefore, there is a need to develop new solutions to enhance the hosting capacity of the distribution grid, and minimise situations where RES feed-in has to be reduced.

For traditional energy system participants, on the other hand, diversifying business models and marketing strategies towards value added services is no longer seen as an option but as a necessity. This is equally true for DSOs as they may face increased local constraints on their grid due to the boom of distributed generation and the anticipated increase of other distributed energy resources, such as electric vehicles and heat pumps.

The flexibility of residential customers will eventually grow in importance, though it will be more challenging to trigger. To have a successful business case in this segment, stakeholders have identified as key prerequisites the existence of price signals, smart metering of energy consumption (at least on an hourly basis), automation of processes, simplicity of load control, and visibility of benefits.

The availability of dynamic pricing models within the spot market is expected to trigger more implicit DSF in combination with the development of tailor made flexibility services. With implicit DSF, shifting decisions as a response to price signals remain in the hands of the process owner (company). In addition, direct contractual arrangements between (industrial) consumers and network operators/ aggregators/ suppliers, for example for load control, should further increase the use of explicit demand response for which the shifting decision is passed on to an external party. The two approaches lead to different transaction costs and present different economic potential[15].

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[14] COM(2012) 663 final

[15] Please see section 2.4 of our consultation document for a more detailed explanation of implicit and explicit pricing for DSF.

Regulators will need to further analyse the implications for consumers of dynamic pricing such as time-of-use tariffs, time of use network tariffs or any other dynamic pricing element (which could also be location specific). They will have to consider ways in which efficiency in the use of the network may be encouraged, e.g. to assess in more detail how specific components/characteristics of network tariffs might impede the emergence of DSF.

CEER recognises that competition requires careful oversight, to ensure that customers are treated fairly, get the best possible deal available and are empowered to exercise their right to choose on an open market. Regulated prices (when set below costs) can distort the functioning of the competitive market and hinder the goal of customer protection and participation. The impact of all regulated prices on the emergence of DSF will need to be monitored to ensure distortions on national and neighbouring markets for DSF are avoided.

More opportunities for DSF should emerge from it having increased access to all available energy markets (balancing, wholesale, retail and capacity) and through adapted requirements for that access allowing for competition between generation and DSF on an equal footing. However, due to the complexity of energy markets (perceived as a market barrier), notably the design of national balancing systems, suppliers and portfolio management firms (e.g. aggregators) will play an important role in promoting products and services to facilitate more active demand-side participation in wholesale markets. Through DSF, market parties may bear responsibility for balancing their short-term portfolios which can create a considerable efficiency gain contributing to market integration.

Alongside the emergence of new DSF services, new actors, such as aggregators and Energy Service Companies (ESCOs), with business models that offer consumers a market valuation of their flexibility have entered the arena and are staking a claim to a level playing field with the historic incumbent providers of DSF (often the consumers' existing suppliers). The emergence of these new actors in many European markets presents opportunities and challenges to regulators, consumers and previous market participants.

Therefore, while assessing the barriers that have to be addressed in order to allow the full implementation of the EED requirements, regulators also need to make sure that non-discriminatory access to the flexibility of the consumers is ensured. This specific point addressed in our consultation document has been confirmed through responses to that consultation and by views raised at the public workshop and other fora.

6 Conclusions

Based on the experience of the public consultation and workshop as well as the expertise of its member NRAs, **CEER has agreed a set of high level principles which we believe should govern Demand-Side Flexibility and enable it to play an unhindered role in European energy markets.**

Following on from this, we have **also set out some actions which CEER (and other parties) will take forward in the short to medium term.** These are high level recommendations which in some cases set the scene for the more detailed examination and development in work which CEER (and ACER and other parties) will take forward in the coming years.

While many of these recommendations are similar to others already in the public domain, we hope that this paper can help to identify the 'quick wins' in facilitating DSF while at the same time drawing attention to areas which need further consideration.

Principles governing demand-side flexibility

- As a high-level outcome CEER wants to **unlock the value of DSF for the provider/customer**. This requires:
  - That consumers and market participants have the necessary information and tools to adequately and effectively engage in the market;
  - A market free from barriers that promotes equal access for all parties and new entrants, through interoperable standards and arrangements; and
  - A regulatory framework that is flexible enough to adapt in an evolving market.

- **Consumers should be able to participate actively / provide their flexibility within the market.** Market driven signals such as dynamic pricing or contractual direct load control, automated signals, well designed products and services, and service providers are all key to enhancing the participation of consumers.

- **In a well-functioning market every kind of flexibility should have access, whether it corresponds to an increase or a decrease of the expected consumption level.** By ensuring that the most efficient flexibility option can assert itself, NRAs can help prevent market distortions.

- **An equal footing between DSF and supply resources on all energy markets should be ensured, if they provide the same service to the system.** This can be accomplished when consumers receive concrete economic benefits from providing their flexibility in response to a signal.

- In order to facilitate a level playing field **an independent party should facilitate the administration of the different exchanges (energy, information, financial) between the commercial parties**.

- While respecting commercially sensitive information, there should be mechanisms and processes in place **to ensure that all parties have visibility of the DSF actions taken by any one party which impacts their business**. This will enable those other parties to take account of the DSF in their business operation, without them having their own separate arrangement with the customer. Only **this visibility will allow customers to receive the full, system wide benefit of their engagement with DSF.**

- **Distortions to market signals that would unfairly advantage or disadvantage DSF should be avoided** in order not to create an artificial bubble or a situation where there is under investment in DSF. Unjustifiable barriers to market entry should be removed.

- **In considering the most cost-effective solutions to local network congestion and security, DSF should eventually be considered alongside traditional network reinforcement options by TSOs and DSOs.**

Specific recommendations/actions for regulators and policy makers

- The roles and responsibilities of all involved actors (market participants, DSOs, TSOs etc.) should be clarified to be consistent with a level playing field.

- MS' standards (e.g. for smart meters, white goods, etc.) and methodologies used to assess the volume of DSF provided (such as the baseline) should be compatible with other MS' so as to avoid a lack of interoperability across the EU or market distortions.

- The role of DSOs (and the structure of network tariffs) in an evolving market needs to be examined[16]. In this context, NRAs and other relevant parties should assess the (technical) options for DSOs to contract DSF services from a third party (e.g. supplier, aggregator, virtual power plant) as an additional tool for local congestion management (re-dispatching measure) within the current (unbundled) regulatory framework and in respect of a level playing field for all involved parties.

- All relevant actors (ACER, NRAs, MS, EC, ENTSOs) should continue to ensure that the relevant network codes maintain a focus on promoting demand-side equally to supply and other flexibility measures (e.g. Demand Connection Code, Load Frequency Control and Reserves, and Electricity Balancing).

- NRAs and other interested parties should continue to undertake studies and commission technical analysis to quantitatively assess and compare the status and potential of DSF across the EU, including specific details on prices/contracts and the volumes of energy involved. The results should quantify how much DSF is being used currently to balance the system, how much DSF is used at the distribution, commercial and domestic levels, and how much of this value is being passed on to end-use consumers, including residential consumers[17].

- NRAs should continue to observe if the market and regulatory arrangements for DSF are such that the whole system-wide benefits of DSF (at the generation, transmission, distribution and supplier/retail levels) are passed on to end-use consumers in a fair and transparent manner.

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[16] The forthcoming CEER Green Paper on Role of the DSO will examine this issue.

[17] As part of the its planned 2014/2015 deliverable, 'Demand response and energy efficiency services: Benchmarking report and case studies', it is currently envisaged that CEER will examine a small number of simple quantitative benchmarks to look at, for example, the number of demand-side response offers and the number of customers taking up these offers across MS. It will be necessary for CEER and/or other interested parties to add to this work to produce a more detailed technical assessment.

Annex 1 – CEER

The Council of European Energy Regulators (CEER) is the voice of Europe's national regulators of electricity and gas at EU and international level. Through CEER, a not-for-profit association, the national regulators cooperate and exchange best practice within and beyond Europe's borders. CEER includes national regulatory authorities from 33 European countries (the EU-28, Iceland, Norway, Switzerland, FYROM, Montenegro and growing).

One of CEER's key objectives is to facilitate the creation of a single, competitive, efficient and sustainable EU internal energy market that works in the public interest. More specifically, CEER is committed to placing consumers at the core of EU energy policy. CEER believes that a competitive and secure EU single energy market is not a goal in itself, but should deliver benefits for energy consumers.

CEER works closely with (and supports) the Agency for the Cooperation of Energy Regulators (ACER). ACER, which has its seat in Ljubljana, is an EU Agency with its own staff and resources. CEER, based in Brussels, deals with many complementary (and not overlapping) issues to ACER's work such as international issues, smart grids, sustainability and customer issues. European energy regulators are committed to a complementary approach to energy regulation in Europe, with the Agency primarily focusing on its statutory tasks related to EU cross-border market development and oversight, with CEER pursuing several broader issues, including international and customer policies.

The work of CEER is structured according to a number of working groups and task forces, composed of staff members of the national energy regulatory authorities, and supported by the CEER Secretariat.

This report was prepared by the Sustainable Development Task Force of CEER's Electricity Working Group.

CEER wishes to thank in particular the following regulatory experts for their work in preparing this report: Joseph Gildea, Michaela Kollau, James Luger, Yvonne Finger, Romain Benquey and Simon Behrens.

Annex 2 – Definitions and abbreviations

ACER: the European Agency for the Cooperation of Energy Regulators.

Aggregator: an entity which offers services to aggregate energy production from different sources (generators, consumers) and acts towards the grid as one entity, including local aggregation of demand (demand-response management) and supply (generation management).

Balancing Responsible Party (BRP): means a market-related entity or its chosen representative responsible for its imbalances.

Balancing Service Provider (BSP): a market participant providing Balancing Services to its connecting TSO, or in case of the TSO-BSP Model, to its contracting TSO.

CEER: the Council of European Energy Regulators.

Consumer: includes all residential, agricultural, industrial and commercial end-users of electricity.

Contractual DSF: characterised by a contractual agreement between the consumer and the party who requires the service. Consumers can voluntarily sign up to such programs, but after joining, demand adaptation is usually not an option but a contractual arrangement. These programmes include direct load control, interruptible/curtailable rates, emergency demand response programmes, capacity market programmes and ancillary-services market programmes.

Demand-side flexibility: the capacity to change electricity usage by end-use customers (including residential) from their normal or current consumption patterns in response to market signals, such as time-variable electricity prices or incentive payments, or in response to acceptance of the consumer's bid, alone or through aggregation, to sell demand reduction/increase at a price in organised electricity markets or for internal portfolio optimisation.

The objective of such market signals is to induce modulation (increase or reduction) of electricity usage and to optimise usage and balancing of networks and electricity production and consumption, for example by consuming less during peak times or by facilitating the integration of increasing electricity generation from variable renewable energy sources and micro-generation.

Demand-side management: the planning, implementation, and monitoring of activities designed to encourage consumers to modify patterns of electricity usage, including the timing and level of electricity demand. Demand-Side Management includes demand response and demand reduction.

Demand-side participation: the term given to an actor (consumer, supplier, DSO, TSO, third party, or private company) who actively participates in a demand side action either directly, through facilitation, or through receiving the benefits of that demand side action.

DSO: distribution system operator.

Dynamic demand response: demand-side response that is in reaction to signals whose pattern changes, sometimes in line with real-time data. This is distinct from static-demand response.

Electricity demand reduction: the voluntary or involuntary reduction in electricity demand by end-use consumers**.**

Energy efficiency: the ratio of output of performance, service, goods or energy to input of energy consumption. Energy efficiency is a way of managing and restraining the growth in energy consumption. Something is more energy efficient if it delivers more services for the same energy input, or the same services for less energy input. **EED:** Energy Efficiency Directive.

Energy service provider: a natural or legal person who delivers energy services or other energy efficiency improvement measures in a final customer's facility or premises.

Energy Service Company (ESCO): a commercial company providing a broad range of energy solutions including designs and implementation of energy savings projects, retrofitting, energy conservation, energy infrastructure outsourcing, power generation and energy supply, and risk management.

Electricity storage: a device or apparatus that allows electricity to be stored in some form to be used later as electricity on a network. There are multiple storage methods currently in use or under trial/study.

Flexibility: includes demand-side flexibility/response, storage, interconnection, flexible generation, and automated network management.

Flexible generation: generating capacity whose output can be varied to meet the needs of the system. Flexible generation is said to be dispatchable.

Peak shifting/shaving: the flattening of an electricity consumption load curve. The peak demand at midday is e.g. shifted to a different time of the day e.g. early afternoon, when prices are lower; or the peak demand is reduced through an alternative energy source e.g. electricity production with a diesel generator.

Price-based DSF: customer response is triggered by price changes that reflect variations in the underlying costs of electricity generation. This form of DSF comprises time-of-use tariffs, critical peak pricing, or real time pricing. It enables consumers to shift their consumption to cheaper time periods in order to reduce their electricity bills.

Prosumer: a participant in energy markets who both consumes and generates energy which can be shared with the DSO, supplier, or other consumers.

TSO: transmission system operator.

Valley Filling: the flattening of an electricity/gas consumption load curve. Load is shifted from peak times to low/zero demand times e.g. in the night.

Annex 3 – Results of Internal NRA survey and Public Workshop

Internal NRA survey

The survey explored how demand-side flexibility arrangements operate in different countries (with a particular focus on regulatory responses to the implementation of the Energy Efficiency Directive 2012/27/EC).

The results of this survey provided a useful first impression of activity between different National Regulatory Authorities (NRAs) helping to inform some national case studies and a high level summary of the regulatory position in relation to demand-side flexibility. Some of the key messages emerging from the survey are outlined below (more detail can be found in the consultation document).

- DSF was considered to be explicitly mandated in only a few MS (Austria, France, Germany, Hungary and Portugal). Adoption of the Energy Efficiency Directive should change this.
- Some NRAs have specific roles, though these were predominantly pilot projects and R&D based. An interesting example was the offer of real-time wholesale prices for retail users (Netherlands).
- In the context of Article 15.4 of the EED which refers to tariffs and energy efficiency, several countries have had longer term experience with the use of network tariffs and regulation to improve efficiency, including in trying to reduce network losses.
- Although national legislation is often seen as the driver for the uptake of tariffs and regulation, only Portugal and France stated that they had a legal mandate.
- The absence of smart metering in households is seen as a key barrier to demand-side flexibility which if addressed could also be one component of achieving customer awareness of energy efficiency.
- There are differing market structures for enabling/constraining demand-side flexibility, ranging from countries where DSF is not permitted to those where it is active in the day ahead, balancing or other energy markets.
- Minimum sizes for the provision of balancing services may constrain the emergence of DSF but pooling is in many cases a potential solution.
- Emerging factors (enabling/constraining) affecting demand-side flexibility include the minimum size of take up of smart meters, the openness of capacity mechanisms (where they exist) to DSF, and the rationale/potential for DSF in non-connected systems such as islands.

This initial work also informed our definition of demand-side flexibility as incorporating both market-led and network-led approaches, based on some form of signal and response being exchanged between the energy system participant and customer (see Chapter 2 of this report).

Public Workshop

The public workshop held at the CEER premises in Brussels on 18 November 2013 served as a useful forum for stakeholders to provide first reactions to our consultation questions and to discuss the wider context of DSF including what stakeholders viewed as barriers and opportunities as well as the importance for consumers. A summary of the workshop and its presentations can be viewed here.

Public Consultation

CEER conducted its public consultation on the Regulatory and Market Aspects of Demand-Side Flexibility from 18 November to 20 December 2013. The consultation attracted 39 responses from various stakeholders across the EU. An evaluation and full list of the non-confidential responses can be viewed here.

Annex 4 – Case Studies

It was not possible to include the case study below in our consultation document. In it the Portuguese regulator ERSE outlines the situation with regard to time of use (ToU) tariffs and critical peak pricing (CPP).

Case study – Portugal

In Portugal, time of use tariffs have been in place for a long time and a significant percentage of consumers use them.

A ToU tariff option split into two time periods makes up 27.3% of Normal Low Voltage (NLV) consumers (those with less than 20.7 KVA total consumption, i.e. mainly residential) on the Portuguese mainland, 3.2% in Azores and 11.6% in Madeira. Another ToU tariff with three time periods represents 31.2% of NLV consumers in the Azores[18]. NLV consumers with less than 20.7 kVA consumption make up 35% of total Portuguese demand.

For Normal Low Voltage consumers between 20.7 kVA and 41.4 kVA (i.e. commercial/small industrial), a tariff option with three time periods is in place and is mandatory (no flat tariff option exists). This group of consumers (20.7KVA-41.4KVA) represents 8% of total Portuguese demand.

For Special Low Voltage (SLV) consumers (above 41.4 kVA) four time period ToU tariff option is in place. Again this is mandatory and this group of consumers makes up 7% of total demand.

For higher voltage levels (Medium Voltage, High Voltage and Very High Voltage, MV, HV, VHV) a four time period ToU tariff is in place as a minimum requisite. Consumers may choose ToU tariffs up to hourly values making dynamic pricing possible, depending on the market functioning. The MV-HV-VHV group of consumers accounts for 50% of the total demand in Portugal.

In other words, access tariffs for these voltage levels are mandatory at 4 time periods, and the meters allow also the energy component to be priced on an hourly basis[19]. Due to the large penetration of renewables in Portugal, ERSE wants to go further in encouraging more dynamic tariffs/pricing.

The revision of the Tariff Code of July 2011 establishes that, with the objective of introducing dynamic tariff options, the TSO and DSO of Portugal's mainland and islands (Azores and Madeira) have to regularly send the regulator studies on:

- the viability of the introduction of this type of tariff;
- the definition of the necessary variables to design these tariff options; and
- any other relevant issues for the introduction of this type of tariff.

[18] Tariff options in the Azores consist of a flat tariff, 2 period ToU, and 3 time period ToU.

[19] Currently, the energy component is usually priced on a 4 time period basis.

Following the results of these studies, pilot projects will determine if the introduction of dynamic pricing will have a net positive benefit, both on the mainland and on the islands where regulated prices are permitted. The experience acquired from these pilot studies may enable an application of dynamic pricing on a much larger scale.

In this way ERSE is creating the regulatory framework for the innovation of grid access tariffs, establishing tariff options that lead to the active participation of users. In the medium to long term these users may choose, for example, CPP tariff options as they become acclimatise to engaging with different pricing and tariffs, and gradually participate in more valuable forms of DSF.

Higher renewable penetration creates more volatility in terms of energy costs, system service costs, and grid allocation costs. Therefore DSF will be more and more valued going forward. The flexibility introduced by CPP options allows that demand, motivated by strong price signals applied in critical times for networks or generation, follows offers variations. In this context, the introduction of CPP options in the grid access tariffs has the following objectives:

- To allow consumers to participate in mechanisms that lead to a more efficient use of the grids and consequently allows minimized grid costs, in benefit for all consumers.
- To provide to the grid operators an alternative mechanism to minimize grids use costs, since it allows the reduction of demand in situations of higher consumption and the postponement of new investments.
- To allow the minimization of the variable costs for generation and system operation.
- To allow the benefits obtained from grid, energy, and ancillary services costs to contribute to wider electricity system security

Assorted studies highlighted by responses to the public consultation

23 respondents to the CEER public consultation on DSF provided links to relevant or related studies. A small number addressed the question of the costs and benefits of demand-side flexibility measures to a limited degree, although a direct comparison is difficult as they refer to different countries and the studies are based on different assumptions and preconditions.

What follows is an overview of the studies which gives a snapshot of some of the benefits of DSF as well as a selection of related quantitative and qualitative data grouped under thematic headings.

Demand-Side Flexibility / Demand Response

- The study "Smart Tariffs and Household Demand Response for Great Britain"[20] published by Sustainability First together with the Brattle Group identified some possible economic and carbon savings from household demand response in the UK. These savings and benefits are based on several preconditions (such as the roll out of smart meters) and measures which should follow the preconditions identified in this study. The results show potential customer benefits and CO_2 savings from household demand response in the order of €1.2-3.1 million[21] for electricity demand reduction and up to €318 million for electricity ToU tariffs/load shifting for the period 2021-2030. For the same period the CO_2 savings from demand reduction and load shifting are estimated between 7-18 and 0.4-1.8 Mt CO_2 respectively[22].

- The "Empower Demand"[23] study by VaasaETT, a global energy think tank, reviewed over 100 pilots that dealt with dynamic pricing programmes enabled through smart metering technologies. The large comparative sample indicates that ToU, Real-Time-Pricing, etc. do effectively reduce energy demand during periods of high prices.

- Energy Pool (2013) estimates total peak clipping capabilities through demand response between 6% - 11% (corresponding to 35 - 60 GW). VDE's study "Demand Side Integration"[24] described a theoretical German DR-potential of 25 GW in 2010 (to be doubled by 2030), of which 8.5 GW are technical/economical potential, confirmed by the dena-Netzstudie II. Smart appliances have a large potential. The project SMART-A estimated that the demand response potential in the EU by smart appliances only was about 60 GW of controllable load, of which 40-42 GW are economically viable.[25]

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[20] http://www.sustainabilityfirst.org.uk/docs/2010/Sustainability%20First%20-%20Smart%20Tariffs%20and%20Household%20Demand%20Response%20for%20Great%20Britain%20-%20Final%20-%20March%202010.pdf

[21] All figures in British Pounds have been converted to Euros using the 2013 ECB Average Exchange Rate of 1€:£0.8493

[22] *Estimated Economic and Carbon Potential from Household Demand Response to 2030, Source: [Sustainability First, "Smart Tariffs and Household Demand Response for Great Britain", March 2010]*

[23] http://www.vaasaett.com/2012/03/final_empower/

[24] http://www.vde.com/de/Verband/Pressecenter/Pressemappen/Seiten/Energiespeicher.aspx

[25] All from European Commission Staff Working Document, 'Incorporating demand side flexibility, in particular demand response, in electricity markets' (2013)

- In 2008, Capgemini explored the development of demand response throughout the EU-15 and, under its dynamic scenario (increased implementation of demand response programmes, achievement of the EU 20% energy saving objective, full implementation of advanced smart meters or smart energy boxes by 2020), predicted €25 billion in annual electricity bill savings for customers by 2020 as well as €50 billion in avoided investment related to peak generation capacity[26].

- The final report for the European Commission on “Benefits of an integrated European energy market” (June 2013)[27] identifies material gains from demand side response (by reducing the requirement for additional generation and transmission capacities) in the order of €4bn per year across Europe. The dena0Netzstudie II identified cumulative potential savings of €10 billion for Germany alone.

- In an evaluation made by the European Commission Services on the basis of available expert research, including the Impact Assessment accompanying the Commission’s proposal for the EED (SEC(2011)779)[28], energy savings across Europe from demand response have been estimated to be at a minimum of 15 Mtoe in 2020. Capgemini’s 2008 study estimated that the savings could amount to 100 TWh of annual energy savings in a conservative scenario, achieving 200 TWh of annual energy savings under its dynamic scenario.

- In an Imperial College London analysis[29], demand-side response (DSR) tends to have the highest value compared to other balancing technologies. The analysis does, however, assume there are no costs associated with DSR. Although smart meters have already been mandated (and could be considered the main technology cost) in reality there are likely to be further technology and non-technology costs associated with the deployment of DSR. These might include equipment so appliances can communicate to the smart meter, data and communications costs, system upgrades for suppliers, product changes or the need to compensate consumers or reward certain behaviours. This means that the analysis may overestimate the value of DSR, particularly in comparison with storage. Nevertheless, even at low penetration (10%) there are considerable benefits across all pathways.

- E.ON internal studies describe the benefits of demand-side flexibility options for retail customers vis-à-vis the need for energy intensive appliances (e.g. heat pumps, micro-CHP). For commercial and industrial customers, DSF solutions can offer benefits greater than the associated costs, especially if generation overcapacity is reduced.

Consumer behaviour and retail tariffs

26 http://www.capgemini.com/resource-file-access/resource/pdf/Demand_Response__a_decisive_breakthrough_for_Europe.pdf

27 http://www.europarl.europa.eu/RegData/etudes/etudes/join/2013/504466/IPOL-JOIN_ET(2013)504466(ANN04)_EN.pdf

28 http://ec.europa.eu/energy/efficiency/eed/doc/2011_directive/sec_2011_0779_impact_assessment.pdf

29 Referenced in the UK Department of Energy and Climate Change (DECC)’s ‘Electricity System: Assessment of Future Challenges – Summary’, 9 August 2012 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48549/6098-electricity-system-assessment-future-chall.pdf

- The report “Demand Side Response in the domestic sector- a literature review of major trials”[30] by Frontier Economics and Sustainability First reviews 30 DSR trials in the domestic electricity sector. Key findings include that consumers do shift electricity demand in response to economic incentives; that interventions to automated responses deliver the greatest and most sustained household shifts in demand where consumers have certain flexible loads, such as air conditioners or electric heating; that after automation, a combination of economic incentives and enhanced information generally delivers the greatest demand response; and that consumer feedback on tariffs and interventions aimed at encouraging DSR was generally positive.

- However, the same study suggests that testing of real-time pricing for households has not produced robust results and there is limited evidence on the way consumers shift their electricity use in response to incentives. For example, with the exception of air-conditioning and storage heating, it is not clear which appliances consumers are willing to use in a flexible way. In addition, there is limited evidence on whether DSR persists over time if it is not automated or directly controlled.

- In the Electricity Smart Metering Customer Behaviour Trials in 2011 (of the Commission for Energy Regulation in Ireland) it was noted that consumers tended to overestimate how much money they would save by reducing peak usage, until they received a bill. Some consumers were disappointed by how much they had saved, leading to risk of disillusionment; this suggests that the peak shifting would not necessarily be a long-term effect or that measures would be needed to establish/manage expectations.

- The Sustainability First (UK) 2010 study on Smart Tariffs and Household Demand Response for Great Britain[31] references separate studies/trials in Canada, the USA, Northern Ireland and Australia with the following results.

- **Northern Ireland:** time of use tariff trials suggested that many prepayment users actually benefited from time of use tariffs without having to change their behaviour. The Keypad Powershift trial was undertaken with 200 customers from October 2003 to September 2004. 18 100 customers were given 4 time bands and 3 ToU tariff rates. They were compared to a control group of 100 customers with a flat-rate tariff. The average spend by those on the ToU tariff was €438 compared to €463 by the control group. However, if the time-of-day price bands had been applied to the control group’s usage, they would have paid €445, saving around three quarters of the amount that those who were aware of the ToU bands saved.

  This may suggest that that much of the saving for the PMG was passive (i.e. reflecting lower use at peak periods by keypad customers in general) rather than an active response to the price signal. This may be because the trial participants are at home during the day and thus use appliances more at off-peak times.

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30 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48552/5756-demand-side-response-in-the-domestic-sector-a-lit.pdf

31 http://www.sustainabilityfirst.org.uk/docs/2010/Sustainability%20First%20-%20Smart%20Tariffs%20and%20Household%20Demand%20Response%20for%20Great%20Britain%20-%20Final%20-%20March%202010.pdf

- **USA:** in Californian trials of Critical Peak Pricing (CPP), high-use customers responded significantly more in kW reduction than low-use customers, but low-use customers saved significantly more in percentage reduction of their annual electricity bills than high-use customers. Low-use customers saved an average of 4.0% on their electricity bills, while high-use customers saved an average of only 1.7%.

- **Canada:** in March 2007, Hydro One Networks Inc. (Hydro One) received approval from the Ontario Energy Board (OEB) for a pilot project involving 500 residential, farm and small business customers for 5 months (May to September 2007) to assess their response to TOU pricing. Instead of paying the Regulated Price Plan (RPP), pilot participants were asked to pay the OEB-approved RPP TOU rates. In this pilot, the peak period was 11am-5pm on weekdays, with 7-11 am and 5-10pm mid-peak and 10pm-7am off-peak. All times at weekends were also off-peak.

- Most Hydro One pilot participants (76%) were better off with the RPP TOU rates during the pilot period. Customers who were better off on average gained about $6 per month, while customers who were worse off on average lost about $2 per month. As in the Northern Irish study above, 32% of pilot participants were better off on the RPP TOU rates without needing to use any less electricity overall. These customers were likely to have a greater percentage of usage during the mid-peak and off-peak periods.

  In the pilot, about 14% of customers were worse off under the RPP TOU rates, despite making an effort to reduce their electricity consumption relative to the previous year. These customers are likely to have a greater percentage of consumption during on-peak and mid-peak periods.

  The researchers concluded that customers who are at home during the day will likely be negatively affected by the RPP TOU rates and will need to shift and/or conserve more in order to offset the impact. They also concluded that customers with low electricity usage are likely to be negatively impacted or less able to engage with RPP TOU pricing, as there is only a limited amount of load above the base load that they are able to shift or conserve.

Energy efficiency

- Another trial from Energy@home[32] was able to show an average energy saving of 11 % due to the use of smart appliances (i.e. smart washing machine). In this trial, 50 users used a smart management-metering system over a period of 6 months.

Smart Grids and Smart Meters

- In its recent paper “Smart Grids: Future proofed for consumers?”[33] Consumer Futures studied the development of smart grids and demand side response from the perspective of British energy consumers. Consumer Futures found that calculations of the benefits of demand side flexibility to the electricity system and actors within it vary considerably.

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32 http://www.energy-home.it/Documents/Energy@home%20Workshop%2026Nov2013/05-BellifemineEtAlEnergyAtHome.pdf

33 http://www.consumerfutures.org.uk/files/2013/07/Smart-grids.pdf

- A study by Redpoint and Element Energy for DECC suggests that DSR from domestic households could save between €71 million and €589 million a year by 2030 in Great Britain[34]. The analysis claims that if all of these savings were shared equally among all consumers, this could translate to between €5.89 and €17.67 a year per household, or, if the savings were passed only to those on DSR tariffs, up to €106 per household. The savings included in the analysis are reductions in generation investment and operation, and distribution network investment costs, but not apparently transmission cost savings.

- The most recent Smart Metering Impact Assessment (SMIA), published by DECC in April 2012, puts an overall value of €966 million to 2030 for static DSR in Great Britain[35].The figure of €966 million was obtained by summing the figures quoted for avoided network investment, generation short run marginal cost savings, and avoided generation investment from TOU tariffs – about €47 million a year. This figure does not include any benefits from dynamic DSR but it does include avoided investment for the transmission network. These benefits are labelled in the SMIA as accruing to industry, rather than to consumers as in the Redpoint work.

- Imperial College London analysis assessed the potential value of Automated Demand Response (ADR) as part of wider study examining the functionality of ADR[36]. The net present value of the cost of ADR was estimated at between approximately €67000 and €115,000 per building over 30 years, based on deployment as per this trial in 20 buildings. Estimates of network reinforcement costs were used to calculate the minimum levels of demand reduction that ADR in this cost range must achieve to make it a financially viable alternative to reinforcement. Minimum levels were then compared to expected summer and winter load shed from the buildings studied as above. This indicated that the expected reductions in summer load from the three individual buildings studied would exceed the minimum, making ADR viable if network reinforcement is driven by demand peaks in summer, rather than winter.

- The project SMART-A estimated that the broad use of smart appliances could yield an increased uptake of wind power in the system of up to 70% and a reduction of fossil fuel consumption of up to 6% by 2025. For Germany, VDE estimates a controllable amount of electricity of 43 TWh by 2030.

[34] Redpoint and Element Energy (2012) Electricity Systems Analysis – Future System Benefits from Selected DSR Scenarios for DECC)

[35] (DECC (2012) Smart Meter Roll Out for the Domestic Sector Impact Assessment, Annex 3

[36] https://www.ofgem.gov.uk/ofgem-publications/45830/sset1004-closedown-report.pdf

Annex 5 – Related Documents

CEER documents

- Status Review of Regulatory Aspects of Smart Metering, Ref: C13-RMF-54-05, 12 September 2013
- CEER Response to the European Commission Green Paper "A 2030 Framework for Climate and Energy Policies", Ref.C13-SDE-36-03, June 2013
- CEER/BEUC A 2020 Vision for Europe's energy customers, May 2013 (updated)
- CEER response to draft THINK report: "From distribution networks to smart distribution systems: Rethinking the regulation of European DSOs", Ref: C13-SG-09-04, 31 May 2013
- CEER response to draft THINK report "Shift, not drift: Towards active demand response and beyond", Ref: C13-CRM-69-05, 31 May 2013
- CEER Status Review on the Transposition of Unbundling Requirements for DSOs and Closed Distribution System Operators, Ref: C12-UR-47-03, 16 April 2013
- CEER Advice on the take-off of a demand response electricity market with smart meters, Ref.C11-RMF-36-03, December 2011
- CEER status review of regulatory approaches to smart electricity grids, Ref. C11-EQS-45-04, 6 July 2011
- CEER submission to European Commission Consultation on Alternative Dispute Resolution (ADR), Ref. C11-RMC-46-03, 8 March 2011
- GGP on Regulatory Aspects of Smart Metering for Electricity and Gas, Ref. E10-RMF-29-05, February 2011

External documents

- Shift not Drift: Towards Active Demand Response and Beyond, Florence School of Regulation THINK Report, topic 11, May 2013
- Potential Implementation of Demand Side Approach Methods in ERRA Countries, ERRA Licensing/Competition Committee Case Study Paper, January 2009

EU legislative and European Commission documents

- COMMISSION COMMUNICATION on Delivering the internal electricity market and making the most of public intervention (including its accompanying Staff Working document on Incorporating demand-side flexibility, in particular demand response, in electricity markets)

- DIRECTIVE 2012/27/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU

- COMMISSION RECOMMENDATION on preparations for the roll-out of smart metering systems, C(2012) 1342 final