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Council of European Energy Regulators

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Sustainable Development Task Force

Regulatory and Market Aspects of Demand-Side Flexibility

A CEER Public Consultation Document

Ref: C13-SDE-38-03
8 November 2013

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INFORMATION PAGE

Abstract

In 2013 the Council of European Energy Regulators (CEER) Sustainable Development Task Force (SDE TF) committed to deliver a report exploring the emergence of demand-side flexibility measures within the regulated electricity sector (focussing on market-led and network-led approaches). Demand-side flexibility has the potential to offer a range of advantages, 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 public consultation document (C13-SDE-38-03) seeks to **collect a range of evidence and views on the barriers and opportunities affecting the emergence of demand-side flexibility (DSF) measures**. Our definition of demand-side incorporates both market-led and network-led approaches. (Section 2 provides a definition of these two types of DSF).

In doing so, the consultation also aims to improve our understanding of how **participants in the regulated energy sector** are responding / planning to respond to the relevant requirements in the Energy Efficiency Directive (2012/27/EU) and wider 3rd Package obligations, as well as the 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')*.

This document sets out the background, definitions and high level issues for consideration alongside a series of consultation questions, with the expectation these can be further explored with the input of stakeholders. In addition to this consultation, we will be holding a stakeholder workshop on 18 November to help gather views, before bringing forward the final Advice in Spring 2014. This CEER Advice will support regulators' further work in this area and help inform wider developments in European energy policy.

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; market; network

How to respond to this consultation

Responses to the consultation can be made via an on-line questionnaire.

The consultation will be open for a **6-week period**, closing on **20 December 2013.**

There will also be a consultation workshop on **18 November 2013, Brussels.** Further information is available online.

If you have any queries relating to this consultation please contact:

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All responses except confidential material will be published on the website www.ceer.eu.

For further information, please see CEER's Guidelines on Consultation Practices.

Related Documents

CEER documents

- CEER Advice on the take-off of a demand response electricity market with smart meters, Ref.C11-RMF-36-03, December 2011
- 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 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

Relevant EU Commission documents

- 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
- 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

Further references appear in the main document as footnotes.

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EXECUTIVE SUMMARY

In 2013 the CEER Sustainable Development Task Force (SDE TF) committed to deliver a report exploring the emergence of demand-side flexibility measures within the regulated electricity sector[1] (focussing on market-led and network-led approaches).

Demand-side flexibility (DSF) has the potential to offer a range of advantages to energy sector participants, such as reduced system/consumption costs, enhanced generation adequacy and additional flexibility (particularly in relation to accommodating increasing volumes of intermittent renewable energy sources, or RES). It also carries value throughout the energy system by increasing overall efficiency. Although outside of the scope of this consultation, there are also clear benefits to retail market functioning and consumers (such as reduced bills, and greater control over and engagement with the energy they produce and consume).

However, appropriate market and regulatory arrangements must be in place before this potential can be realised.

This Public Consultation document draws on an initial literature review, inputs from CEER members and an internal survey among national regulatory authorities (NRAs) to establish a view on how demand-side flexibility arrangements (both market-led and network-led) operate in different Member States.

A variety of different parties interact to provide demand-side flexibility – commonly understood to be the capacity by an end-user (either directly or via an intermediary) to change electricity usage in response to a signal (either market-led or network-led). These parties include TSOs, DSOs, suppliers, aggregators and customers (domestic and industrial), and signals can be price-based (e.g. time-of-use tariffs, critical peak pricing) or incentive-based (e.g. direct load control, interruptible rates, capacity markets).

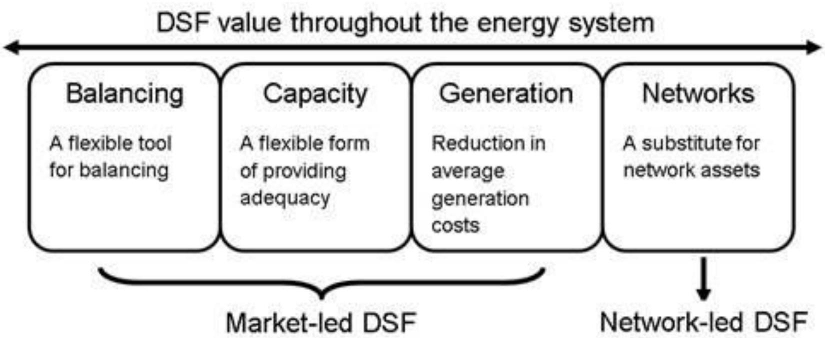

Figure 1: Use of DSF across the electricity system [Source: adapted from Creating the Right Environment for Demand-Side Response, Ofgem 2013]

[1] CEER is aware of the potential for demand-side flexibility within the gas sector, and of the potential benefits demand-side measures may bring to consumers (both domestic and industrial). However, due to the scale and complexity of assessing these areas we have chosen to limit the scope of this consultation to the wholesale electricity market and regulated electricity network only.

Current market regulations were developed to manage large, reliable load, and are less well suited to facilitating flexible demand; in particular, demand-side flexibility is often under-valued as a balancing mechanism. In addition there are a number of other outstanding issues, the resolution of which would facilitate the full potential of demand-side flexibility, such as the development of non-discriminatory market rules (valuing demand equally alongside generation), the interaction of measures with the roll-out of smart infrastructure and technology, the creation of tariffs which provide effective demand-side signals and the provision of necessary tools and knowledge to consumers.

NRAs are now working towards implementation of the 3rd Package, and so are making progress on many of these areas. NRAs have the potential to play a central role in enabling the value of demand-side flexibility services to be realised by shaping market rules, setting out clear roles for regulated companies and market participants and ensuring customers are protected. In addition to action by individual NRAs there is a need for coordination between regulators across Europe, as the large-scale take-up of demand-side flexibility would have a significant impact on the internal energy market.

Regulators are also considering these issues as part of their holistic analysis of what needs to be done to provide a bridge of policy adaptation in the coming decade to deliver and maintain competitive, sustainable and secure energy markets in Europe, through the ACER initiative: Energy Regulation: a bridge to 2025. This work seeks to identify the key issues and evolution of the future regulatory framework for electricity and gas markets taking into consideration the changes and challenges we face. Flexibility, encouraging competition and facilitating the deployment of smart demand, grids and markets are at the centre of this strategic thinking. CEER's work on DSF will feed into this holistic reflection and its accompanying proposals for action.

CEER is seeking views from stakeholders with an interest in demand-side flexibility on a number of formal consultation questions, examining:

- current and future arrangements for demand-side flexibility;
- opportunities and barriers;
- implications of the Energy Efficiency Directive;
- market and regulatory roles; and
- cost effectiveness.

We also welcome responses on wider issues in addition to these specific areas. We will consider the responses we receive and this information, combined with further research, will lead to a CEER Advice paper on matters related to demand-side flexibility in Spring 2014. This work will also inform the proposals being developed as part of "The Bridge", where flexibility (of networks, supply and demand) can be seen as a prerequisite for delivering smart, efficient and competitive markets.

Consultation questions

1) **What do you see as the main opportunities and benefits for demand-side flexibility in existing/future markets and network arrangements?** Please identify, describe and prioritise the opportunities and benefits.

2) **What do you see as the main barriers (e.g. legislative/market/regulatory) to the emergence / functioning of demand-side flexibility?** Please identify, prioritise and explain the key barriers and highlight any essential preconditions[2].

3) **In what way will the implementation of the Energy Efficiency Directive (EED 2012/27/EU) affect your organisation/involvement with demand-side flexibility arrangements?** Please make particular reference to Articles 15.4, 15(8) and Annex XI in your response (summarised in Appendix 4).

4) Have you undertaken/are you aware of **studies examining the cost-benefit of demand-side flexibility measures** (for your country or for your organisation), and/or their cost-effectiveness relative to other measures? What were the results? (Please upload the study here or provide a link; if possible in English.)

5) **Are there any other/wider considerations which we should take into account?** For example, policy developments and technical standards.

[2] These include, for example, (1) a minimum scale of take up/demand for enabling technologies (e.g. electric vehicles, heat pumps, (2) competitive access to consumption data (from smart meters) to allow a competitive market in services to emerge and (3) Flexible distribution networks to manage local demand shifting, etc.

CONSUMER PERSPECTIVE

Through CEER, Europe's energy regulators aim to promote well-functioning and competitive EU energy markets so that consumers receive fair prices, the widest choice of supplier, the highest quality of supply and simple, transparent information about their energy use.

At a time when the European economy as a whole is struggling to return to growth, the challenge of financing the transition to a low carbon, secure and efficient energy system has never been greater. It is vital that the scale of investment necessary to deliver against security of supply and climate goals is secured on a *necessary, proportionate and cost-effective basis*, so as to avoid excessive costs being passed through to consumers.

In this context, demand-side flexibility – if enabled to compete on a level playing field with other measures – has the potential to bring significant benefits to consumers, from both an *engagement and empowerment* (over their own energy use and ability to control bill impacts) and *avoided or deferred investment perspective* (a more flexible grid may defer investment in new generating capacity).

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 CEER launched its joint statement (in conjunction with BEUC, the European Consumers Organisation) on its **2020 Vision for Europe's Energy Customers.**

This joint statement sets out key principles governing the relationship between the energy sector and consumers: ***Reliability, Affordability, Simplicity, Protection and Empowerment.*** Consideration of these principles represents a horizontal theme throughout all of our work.

To this end, CEER calls for consumer interests to be a key consideration during formulation of future EU demand-side flexibility policies.

1 Introduction

The increasing emergence of Renewable Energy Sources (RES) and the further development and integration of European energy markets will in the near future lead to more intermittent and variable energy flows, increasing the requirements on the transmission and distribution networks to manage these flows efficiently and avoid constraints. In addition, global and political decisions can influence the degree of generation adequacy available within Member States, which raises the potential for flexible solutions to contribute (alongside generation) in providing overall ‘system adequacy’. Regulators’ strategic thinking through the Agency for Energy Cooperation’s (ACER’s) initiative “Energy Regulation: a bridge to 2025” recognises the crucial role of flexibility in delivering Europe’s energy markets of the future.

Demand-side flexibility offers one solution to assist with management of the energy (electricity) system alongside conventional approaches (e.g. system balancing) and more novel approaches – such as permanent demand reduction, storage technologies, capacity mechanisms and ‘priority transmission corridors’/ interconnection – all of which have a potential role to play in helping bring about a resilient, cost-effective and flexible energy system.

Demand-side flexibility has the potential to offer a range of advantages to energy sector participants, such as reduced system/consumption costs, enhanced generation adequacy and additional flexibility (particularly in relation to accommodating increasing volumes of RES). It also carries value throughout the energy system by increasing overall efficiency. Although outside of the scope of this consultation, there are also clear benefits to retail market functioning and consumers (such as reduced bills, greater control over and engagement with the energy they produce and consume). **However, appropriate market and regulatory arrangements must be in place before this potential can be realised.**

To better understand these arrangements, CEER undertook an internal survey of its membership to explore 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 a series of detailed case studies (Section 2.7) and a high level summary of the regulatory position in relation to demand-side flexibility (Section 3). 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. (Section 2 provides a working definition of demand-side flexibility.)

This Public Consultation document builds on this activity, and seeks to **collect a range of evidence and views on the barriers and opportunities affecting the emergence of demand-side flexibility measures** from government bodies, academic institutions and energy sector participants. In doing so, the consultation also aims to improve our understanding of how participants in the regulated energy sector are responding / planning to respond to the relevant requirements in the Energy Efficiency Directive (2012/27/EU) and wider 3rd Package obligations.

Following the consultation, the intention is to bring forward a CEER Advice report (incorporating stakeholders’ responses) in Spring 2014. This CEER Advice will support regulators further work in this area and help inform wider developments in European energy policy, including within the context of the ACER "Bridge" project.

1.1 Consultation scope and methodology

Demand-side flexibility affects and interacts with a wide range of issues including but not limited to market and regulatory arrangements, such as technical standards and wider 'sustainable products' policy (e.g. the development of consumer goods – such as washing machines and refrigeration – being able to respond to demand-side signals).

CEER is also aware of the potential for demand-side flexibility within the gas sector.

Given that there is likely to be increased reliance on gas-based electricity generation in many Member States (at the same time as competition for gas globally is increasing, and supplies from certain sources subject to geo-political disruption), and heating is one of the largest areas of energy demand across the EU, the ability to manage short-term reductions in gas use offers potential benefits to both security of supply and consumers (both domestic and industrial).

However, due to the scale and complexity of assessing these areas we have chosen to limit the scope of this consultation to the arrangements governing the wholesale electricity market and regulated electricity network only.

The scope of this consultation therefore focuses on the *current regulatory and market arrangements for demand-side flexibility*, gathering views and information on how demand-side flexibility arrangements (both market-led and network-led) operate in different Member States, how these existing arrangements might facilitate or constrain the effective deployment of demand-side flexibility measures, and how these arrangements may need to change in the future.

This focus also serves to differentiate this consultation from previous CEER research exploring *consumer* engagement with demand response and smart meters (C11-RMF-36-03) and forthcoming work CEER will conduct on Demand Response and Efficiency Services (please refer to the CEER 2014 public work programme for more details).

The consultation is being undertaken against a policy context framed by the provisions of the Energy Efficiency Directive and wider 3rd Package obligations, as well as an increasing level of interest amongst industry participants.

1.2 Methodological approach

In order to better understand how demand-side flexibility arrangements (both market-led and network-led) operate in different Member States, and how these may need to change in the future, CEER has:

- Undertaken an initial literature review (CEER and non-CEER documents), received inputs from CEER members and conducted an internal NRA survey;
- Developed this Public Consultation document (drawing on the above review) with the intention to hold a six -week consultation in addition to a stakeholder workshop;

- An intention to bring forward CEER Advice on matters related to demand-side flexibility by Spring 2014.

1.3 How does this consultation relate to Member States/government interests?

The method and mix of generation, negotiations over energy policy and overall responsibility for energy as a national competence are all decisions and responsibilities of Member State governments. However, as energy regulators, CEER members have an interest in the functioning of the energy market for the benefit of consumers and on the efficient operation of the transmission and distribution networks, and therefore have an interest in 'whole system efficiency' measures.

1.4 How does this consultation relate to ACER?

With a clear overlap in our respective membership and the regulatory focus of our activities, CEER works closely with and supports the work of the Agency for the Cooperation of Energy Regulators (ACER), as well as pursuing a broader variety of issues of interest to regulators.

Subject to timing, the consultation and Advice document (in its developing and/or final version) may be used as a non-formal input to on-going Network Code discussions, particularly those focussed on aspects of the changing nature of electricity demand.

1.5 Structure of the report

Section 1 provides the introduction of the topic and the report.

Section 2 sets out the background, definitions and potential of demand-side flexibility, and introduces a series of NRA case studies to help illustrate the variety of approaches across Europe.

Section 3 provides a high-level overview of current market and regulatory arrangements (based on initial feedback from NRAs) in respect of demand-side flexibility.

Section 4 sets out the formal consultation questions, although CEER welcomes responses on wider issues in addition to the specific areas.

Annex 1 describes the role of CEER, **Annex 2** provides a glossary and explanation of abbreviations used in the report, **Annex 3** provides an overview of pilot studies and active research into demand-side flexibility measures, and **Annex 4** provides the relevant extracts from the Energy Efficiency Directive (2012/27/EU).

1.6 Relevant European policy developments

- In October 2012 the Energy Efficiency Directive (2012/27/EU) was adopted. Article 15 of the Directive requires NRAs to encourage participation of demand-side resources alongside supply in wholesale and retail energy markets.

- The ACER Framework Guidelines on Electricity Balancing state that national and cross-border balancing should facilitate wider participation of demand response[3].

- As part of the EU Third Energy Package requirements[4] for ensuring appropriate conditions for the effective and reliable operation of the networks, the challenges[5] posed by increasing proportions of intermittent RES in the European energy mix have been, in part, addressed through the Framework Guidelines on Grid Connection. As part of this process, ENTSO-E drafted the Demand Connection Code (DCC) - a draft technical standard which provides for a process where transmission operators can propose that demand-side response capability be included in EU design standards (which in turn relates to the Ecodesign Directive).

- As part of the Commission Communication (*Delivering the internal electricity market and making the most of public intervention)*, the Commission has prepared a Staff Working Document on *'Incorporating demand side flexibility, in particular demand response, in electricity markets'.*

[3] FG-2012-E-009 Framework Guidelines on Electricity Balancing

[4] The full list of objectives can be found in Article 36(a) to (h) of the Electricity Directive 2009/72 and 40(a) to (h) of the Gas Directive 2009/73. The Electricity Directive in particular should ensure capacity and infrastructure planning takes account of demand-side flexibility, cost-reflective transmission and distribution tariffs, and the option for demand-side flexibility to tender as new capacity

[5] Such as system balancing and extreme events including blackouts should compensatory mechanisms not be in place when generation levels are low.

2 Demand-side flexibility: Background, definitions and potential

2.1 What is the value of demand-side flexibility?

CEER recognises that in meeting the 20-20-20 targets that there will be an increasing penetration of distributed and renewable energy sources in European Member States with a resultant change in power flows and variability. This sits alongside security of supply and consumer affordability considerations. Addressing these issues collectively may require new ‘system management’ measures, which in turn may see new market participants/relationships and new regulatory arrangements to ensure cost-effective, efficient system operation.

This Public Consultation is focussed on gathering a range of views on **demand-side flexibility** (as one of these new ‘system management’ measures), how current market and regulatory arrangements for this area operate, and how these arrangements may need to change in the future.

For the purposes of this consultation, we intend to build on an early CEER report[6] and utilise a ‘working definition’ of demand-side flexibility.

> *“**Demand-side flexibility** can be defined as **the capacity to** change electricity usage by end-use customers (domestic and industrial) 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.*
>
> *The objective of such market signals is to induce modulation (increase[7] or reduce) 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 electricity from variable renewable energy sources and micro-generation (e.g. behind the meter generation).”*

Box 1: Definition of demand-side flexibility [Source: CEER working definition]

The recent “*Shift, not Drift*” report[8] sets out clearly the ways in which demand-side flexibility can be valuable:

“In the short run, demand response can make balancing easier by shifting demand to times when there is more renewable power available and it can help manage congestion by peak-shaving; thus, helping the integration of renewable energy sources in the electricity system and reducing the high operation costs of flexible generation units. In the long run, this

[6] “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]

[7] An increase in electricity consumption may be desirable when demand is low and negative prices occur.

[8] Shift, Not Drift: Towards Active Demand Response and Beyond, Florence School of Regulation Think report June 2013

operational value of demand response can lead to reduced or postponed investments in network reinforcement and flexible thermal generation, and to less investment to meet decarbonisation targets as the electricity system is used more efficiently."

Demand-side flexibility (DSF) allows industrial and domestic customers to participate in the energy market, benefitting from lower prices and contributing to system reliability, and increases the overall efficiency of the energy system. It can be particularly valuable at times of system stress, either local (e.g. localised network capacity issues) or national (generation capacity excess or shortfall compared with demand).

DSF differs from permanent demand reduction (e.g. energy efficiency), although the two overlap and interrelate considerably, as it involves shifting demand (and therefore load) within a fixed time period in order to meet the available capacity on the system, to participate in the balancing/wholesale market, or to optimise balance groups.

2.2 Where is the value of demand-side flexibility realised?

DSF is a term encompassing various forms of dynamic changes in energy consumption. These changes have value for various parties in the energy system (disaggregated into Balancing, Capacity, Generation and Networks services in Figure 2 below).

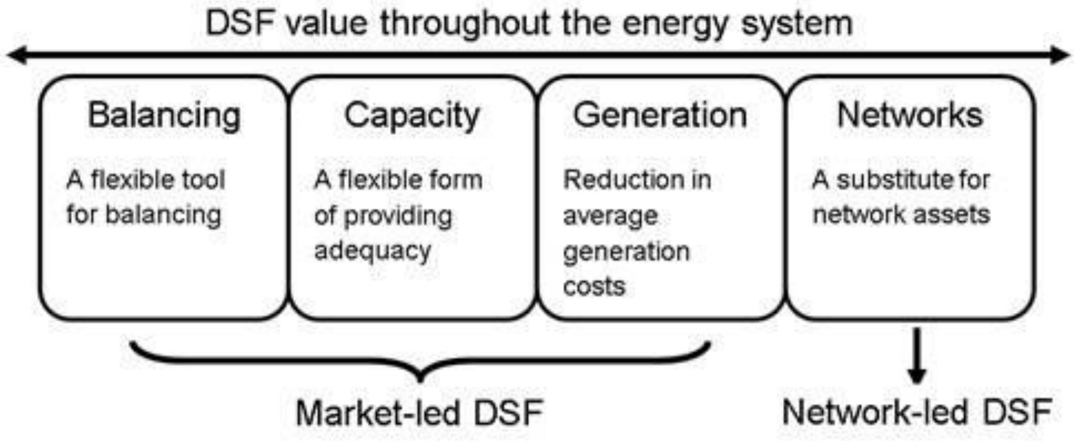

Figure 2: Use of DSF across the electricity system [Source: adapted from Creating the Right Environment for Demand-Side Response, Ofgem 2013]

For **balancing**, DSF could be a tool for the **Transmission System Operator (TSO)** to balance electricity supply and demand on a second-by-second basis across the system or to assist in managing system constraints. It could also be used by **Suppliers** to balance their energy portfolios, to avoid penalties for being 'long or short' on generation.

DSF also has the potential to provide spare **capacity** to the system, which could reduce the volume of generation capacity/adequacy that is required to maintain security of supply levels. DSF could also be used to **shift demand** from higher-demand periods to lower-demand periods ('peak shifting'), reducing the need for higher-cost peaking plants and thereby lowering average costs for generators.

By flattening demand through demand shifting, demand-side flexibility also has the potential to increase overall system efficiency by allowing operational plant to be run at higher efficiencies.

DSF could also be used to accommodate increasing penetrations of intermittent generation, for example by increasing demand in specific areas to reduce curtailment of wind and thus improve wind power load factors.

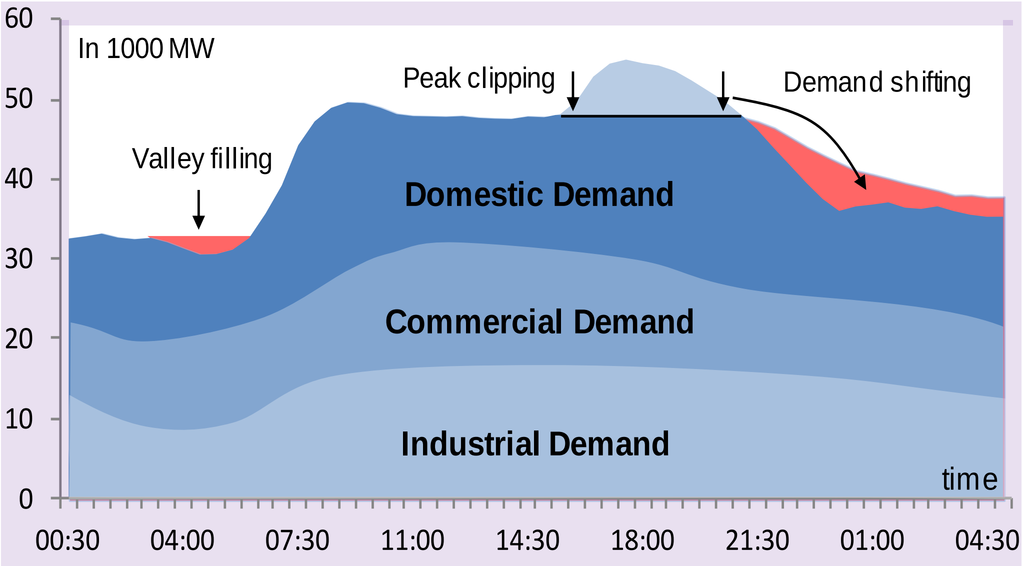

Figure 3: Demand-side flexibility as a balancing service and peak shifting [Source: Electricity Demand-Side Response, UK POSTNote 2013]

Finally, DSF can be used as a **substitute for network assets** when employed in a way that avoids or defers network asset investment, for example enabling a **Distribution System Operator (DSO)** to accommodate local network load growth without having to construct more assets.

One way of characterising different forms of demand-side flexibility services, therefore, is to adopt 'market-led' or 'network-led' to differentiate between the primary recipients of the benefits (recognising that a more efficiently managed network also has secondary benefits to other system participants and consumers).,

2.3 How do different parties interact to provide demand-side flexibility?

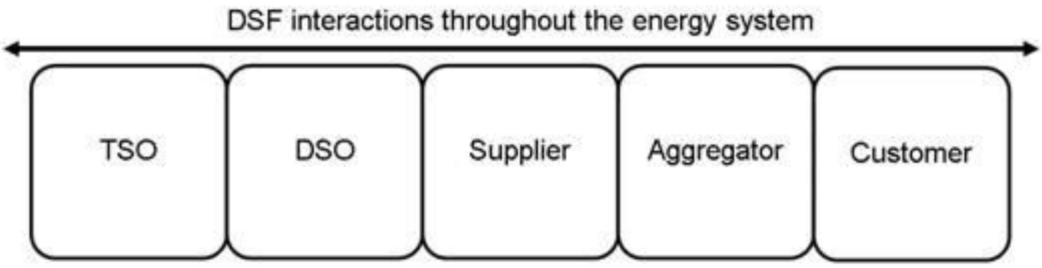

Figure 4: DSF interactions between energy system participants [Source: CEER]

For demand-side flexibility to play a cost-effective ('level playing field') role with other forms of capacity, generation, balancing and networks services, it is important that **effective signals** are able to be transmitted to customers (both domestic and industrial) so that they can respond and increase or decrease their consumption accordingly.

These signals could be in the form of **price-based signals** or **incentive-based signals**.

Any of the parties discussed in Section 2.2 (above) could wish to pass a signal through to customers. **Aggregators** may work on behalf of industrial and/or domestic customers to bundle up individual customer loads for sale or auction in organised energy markets (e.g. system balancing markets)[9].

It is important to mention that for a customer the DSF arrangements may be voluntary (e.g. they can chose to respond to a price signal) or mandatory (a contractual arrangement). Also, DSF routes to market may require exclusivity (e.g. a customer who signs a contract can only offer their demand flexibility to that party) or be non-exclusive.

In the case of **price-based** demand-side flexibility, customer response is triggered by price changes that reflect variations in the underlying costs of electricity generation. These time varying tariffs are an alternative to conventional flat rates and enable users to reduce their electricity bills by shifting their consumption to cheaper time periods. It is important to note that actual demand response in the case of price-based demand reduction programs depends solely on the economic decision of the consumer and it is always voluntary.

Price-based demand flexibility programs can comprise time-of-use tariffs (ToU), critical peak pricing (CPP) or real time pricing (RTP) – see below. Smart metering forms a key precondition for these forms of tariff as interval metering is needed (for example in 15 min values or frequently enough to be able to store data on time of consumption).

Incentive-based demand-side flexibility is 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 they joined, demand reduction is usually not an option but a contractual arrangement[10]. In these programs, in return for a reservation payment or separate incentive payments that are independent from the retail tariff, participants agree to reduce their electricity consumption or to be curtailed in critical hours (programmed events).

An ERRA report[11] suggests a range of possible incentive-based programmes, including: direct load control, interruptible / curtailable rates, emergency demand response programmes, capacity market programmes and ancillary-service market programmes (as per Figure 5 overleaf).

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[9] 2012/27/EC

[10] Most of the time (if not always), the consumer still has the choice, even in real time when being curtailed, to switch off the demand response action. In this regard, the voluntary aspect remains although some form of contract penalty may exist.

[11] Potential Implementation of Demand Side Approach Methods in ERRA Countries, ERRA Licensing/Competition Committee Case Study Paper, January 2009

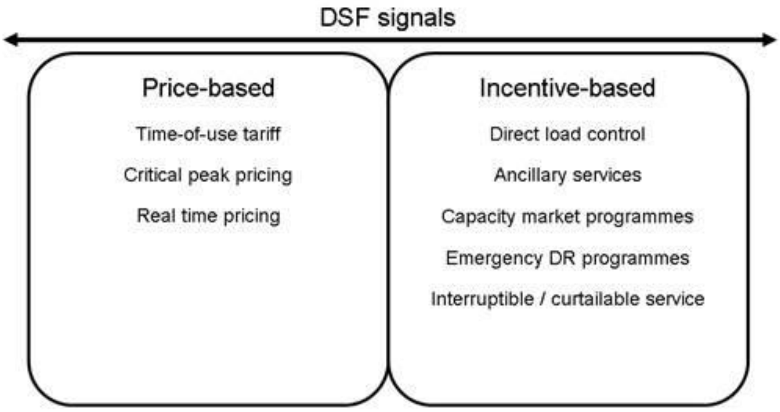

Figure 5: *Types of price-based and incentive-based customer signals* [Source: adapted from Potential Implementation of Demand Side Approach Methods in ERRA Countries, ERRA 2009]

2.4 Market design options for demand-side flexibility

In relation to market design and functioning, price-based and incentive based signals normally occur in **implicit** and **explicit** forms. The following Section provides more detailed explanations of the price/incentive models and implicit/explicit valuation options.

Type of signal	Explanation
Implicit	The purpose of implicit DSF is to lower the consumption level of a supplier and consequently the withdrawals of the balancing-responsible party it relies on (when the two are different subjects). This kind of DSF has been historically developed by suppliers through price-based signals such as CPP to optimise the sourcing costs of their portfolio, especially during peak periods in winter. The implicit valuation of DSF does not necessarily imply any certification, and can be valued for instance in the capacity market to lower the obligation of a supplier.
Explicit	The purpose of explicit DSF is to directly bid the flexibility of the consumer on the market (for instance capacity certificates, energy bids on the wholesale market, capacity tenders for balancing reserves, ancillary services etc.). This valuation of DSF generally implies a control process and specific rules to organise an energy transfer from the seller of the flexibility to the buyer of the flexibility.

These two valuation models of DSF raise some issues regarding the roles & responsibilities of the actors involved, as well as competition issues regarding the access to the flexibility of the consumer. Indeed, DSF can be valued:

1. **Implicitly by the supplier** through specific tariffs

Specific tariff offers can be provided by the supplier to his customers, classically ToU, CPP, or real time pricing; to incentivise consumers to switch their consumption from high-price periods to lower-price periods. Classically, this kind of demand-side flexibility is used by the supplier for internal portfolio optimisation. Consumers are not directly asked to reduce their consumption level, but the tariff better reflects the sourcing costs and critical periods that can occur on the market than “classic” base tariffs, therefore incentivising them to modify their consumption behaviour.

With the roll-out of smart meters and the opportunity to more closely follow the consumption of the residential consumers, these DSF offers will facilitate the offer of more sophisticated tariffs to consumers, and foster competition between suppliers.

2. **Explicitly by the supplier** through a specific DSF contract with its customer for explicit valuation of DSF

A supplier can also chose to specifically contract with his customer to provide DSF when requested by the supplier, independently from the customer’s tariff. Usually, this kind of DSF is used to provide a more accurate result that can be used to fulfil engagements to the TSO or the market (e.g. participation in the capacity market to gain certificates or in the balancing reserves). The consumer is not just incentivised but directly asked to lower his consumption.

3. **Explicitly by a third-party** (e.g. aggregator)

With the liberalisation process and the progressive opening of all energy markets, new market players have shown interest in offering DSF services to the consumers, independently from the supply of energy.

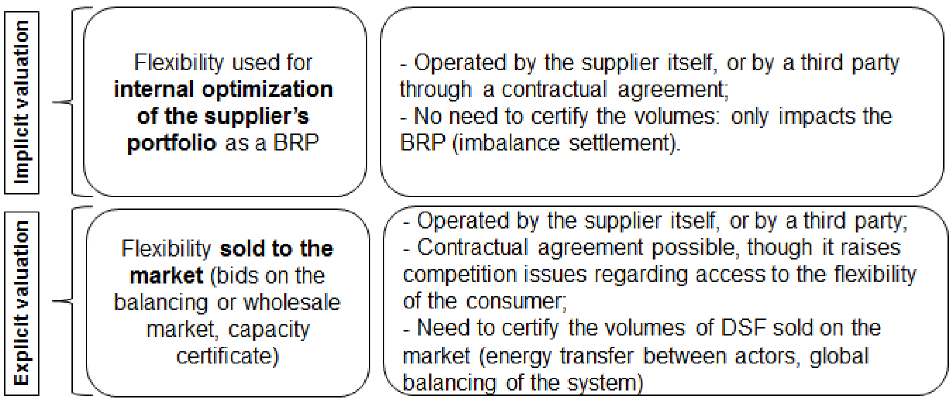

Figure 6: Access to and valuation of the DSF of consumers [Source: CEER]

However, these new actors are in competition with the supplier while accessing the consumer’s flexibility. Furthermore, the supplier may pursue interests which oppose reducing consumers’ consumption level at some specific moments.

This competition issue is of major interest when it comes to designing market rules regarding the valuation of DSF. In France for example, the competition authority stated in 2012 that as the supplier and "pure" DSF operators are in competition, there can be no market design based on a compulsory contract between the two actors. The supplier cannot be in position to refuse access to the flexibility of his clients to a third party.

Due to a transfer of energy from the supplier to the DSF operator, the latter does not have to establish an agreement with the supplier to value the flexibility of the consumer. The DSF operator can buy the energy that is curtailed to provide it to the market, and so supply other consumers (see Figure 7 below). In France, the law now states that the DSF provider can operate without asking the supplier, but has to buy the energy to be able to sell it to the market. To implement these principles, specific energy and financial transfers have to take place so the explicit valuation of DSF can be conducted.

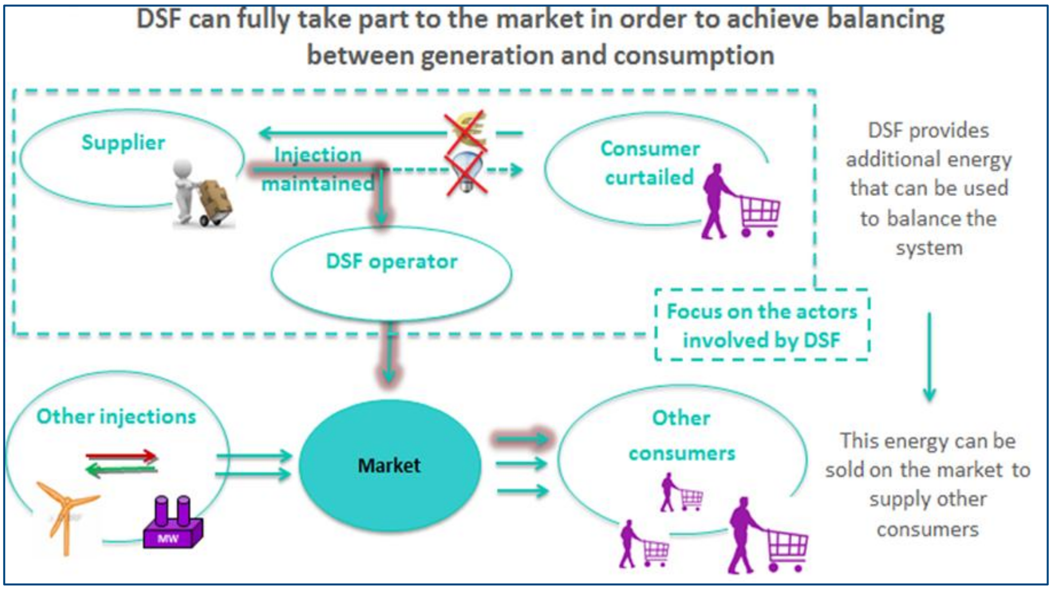

Figure 7: Illustration of explicit valuation of DSF [Source: CRE]

2.5 How is demand-side flexibility currently being facilitated?

Current market regulations were developed to manage large, reliable load from predominantly thermal generation, and are less well suited to management of inflexible 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 beginning to change across Member States. In accordance with the 3rd Package, NRAs across Europe are phasing out regulated energy prices for all consumers[12].

Although not true in all cases (for example, mandatory ToU tariffs in Italy for low-voltage users in the "default service"), the phasing out of regulated pricing should improve the accuracy of market signals, which in turn will lead to more effective demand-side incentives

[12] COM(2012) 663 final

by allowing consumers and micro generators to benefit from the genuine value of shifted demand and generation.

Furthermore, some regulators are moving towards output-based regulation which allows for all sources of flexibility to be considered equally[13]. Both the Italian and UK regulators (AEEG and Ofgem respectively) have begun to regulate energy companies based on outputs, such as reliability or connecting distributed generation, but without specifying the means to achieve them, which makes demand-side flexibility a more feasible proposition when compared to other flexibility services.

However, our preliminary research has identified a number of other outstanding issues, the resolution of which would facilitate the full potential of demand-side flexibility. These include (but are not limited to):

- Establishing clear roles for the parties involved (e.g. TSOs, suppliers, aggregators, manufacturers etc.);
- Specific market rules/access for demand-side flexibility providers to participate in energy markets;
- The phased introduction of demand-side flexibility measures with the roll-out of smart infrastructure and technology;
- Policies and procedures to ensure consumer trust, data privacy and cyber security;
- Innovative tariffs which provide effective demand-side signals to parties; and
- The provision of necessary tools and knowledge to consumers.

CEER invites views on these areas (and others not listed) from stakeholders as part of the Public Consultation.

2.6 Potential role for regulation

NRAs have the potential to play a central role in enabling the value of demand-side flexibility services to be realised. For example, they can set out a clear role for regulated companies and market participants, and can enable the use of demand-side measures as a balancing mechanism.

They play a key role in helping shape market rules, which in turn can enable greater levels of demand-side flexibility participation, and they may (although arrangements differ between Member States) have a role in ensuring customers are protected with regard to smart metering and use of data. As experts on the energy system, NRAs are also well-placed to advise other parties as more flexible systems emerge, and as independent bodies they may be a trusted source of information for consumers.

In addition to action by individual NRAs there is a need for coordination between regulators across Europe, as the large-scale take-up of demand-side flexibility would have a significant impact on the internal energy market. Coordination and collaboration between NRAs could also contribute to enhancing knowledge on the topic that will benefit both the NRAs and wider market participants.

[13] Shift, Not Drift: Towards Active Demand Response and Beyond, Florence School of Regulation Think report June 2013

The need for action by NRAs across Europe is recognised in the Energy Efficiency Directive (2012/27/EU), of which article 15.8[14] states:

"*all NRAs 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*".

This Public Consultation (and the resulting Advice) represents a key contribution to the aim of increasing coordination and collaboration between NRAs on demand-side flexibility developments.

[14] For the complete set of relevant extracts, please see Annex 4

2.7 Demand-side flexibility arrangements across Europe: NRA case studies

The internal survey conducted amongst NRAs revealed a wide range of activity and practices, and several case studies have been developed from this material to help illustrate some of the terms and concepts described in the previous Sections.

In particular, these case studies detail the challenges that remain to the full participation of DSF across different Member States.

2.7.1 Case study – Great Britain

1. Background

Great Britain (GB) is moving towards a lower carbon energy system. Electricity generation from intermittent renewable and distributed sources is increasing. New sources of demand are becoming more prevalent, such as heat pumps and electric vehicles. This shift increases the need to utilise the full potential of all forms of flexibility, including demand-side flexibility (DSF).

A key requirement to the full utilisation of existing and future DSF potential is adequate metering infrastructure. Customers with a peak demand of 100kW or more are required to have meters that measure consumption on an half hourly basis. Figure 8 illustrates that customers on half hourly meters consume about half of all electricity in GB. Further, a smart meter roll-out programme is due to complete in GB in 2020.

Customer	Meter type	Approximate number of meters	Share of GB consumption
Industrial and large commercial	Half Hourly	117,000	50%
Commercial	Non-Half Hourly	2,290,000	16%
Domestic	Non-Half Hourly	27,000,000	36%

Figure 8: GB electricity customers by meter type [Source: derived from Paper 1. GB Electricity Demand – Context and 2010 Baseline Data, Sustainability First 2011]

There are three main routes to market for DSF. This includes time of use tariffs, interruptible contracts, as well as contracts for balancing services. Besides these more established routes to market, other routes are emerging (see following pages).

This case study will describe the more established as well as the emerging routes to market in more detail and will conclude by outlining the role of the Office of Gas and Electricity Market (Ofgem) as the national regulatory authority for Great Britain.

2. Routes to Market for DSF

As described above, there are currently three main routes to market for DSF:

- Time of Use (ToU) tariffs at the domestic customer level and supplier level
- Bilateral interruptible contracts between suppliers and customers

- Balancing (ancillary) services provided by large industry customers, suppliers and aggregators

These three routes are described in more detail in this Section.

Time–of-Use tariffs

Since 1978 suppliers have been offering a (static) discounted ToU tariff (Economy 7) to non-half hourly users to encourage customers to run electrical heating (such as storage heaters) during the night. As its name implies the night or off-peak period lasts for a total of 7 hours. In 2004, this was supplemented by Economy 10 which provided 10 hours of electricity split between night, afternoon and evening. Economy 10 is relatively uncommon. About 5 million households have Economy 7 meters and it is estimated that around 3 to 3.5 million of those are on an Economy 7 tariff[15].

Some customers utilise radio tele-switching arrangements, whereby (in the majority of cases) customers' electrical storage and immersion heating systems are controlled remotely, thus allowing for direct load control. Tele-switching originated from energy management projects initiated in the 1980s. In 2008 there was a major advance when a Central Tele-switching Control Unit utilising modern equipment and software was used to update the previous system. This facilitated easier access and control (for example by internet).

Recent developments have seen the introduction of ToU tariffs for Electric Vehicles (EVs) but this is currently a niche tariff.

Suppliers of electricity also face a form of ToU signal under the Transmission Network Use of System charges associated with Triad demand. Triad refers to the three half hours over the winter period with highest demand. Suppliers are charged a considerable fee (in the order of £20,000/MW (€ 23.682/MW[16])) for peak load, which provides an incentive to minimise consumption at peak.

Interruptible contracts between suppliers and customers

Suppliers can agree interruptible contracts with large gas and/or electricity customers. However, such contracts are increasingly rare partly due to a lack of trust between suppliers and customers and a lack of strong financial incentives. Ofgem is currently consulting on changes to the gas[17] and electricity[18] imbalance charges (cash-out), which might sharpen incentives to negotiate such contracts.

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[15] GB Electricity Demand Project – realising the resource, Sustainability First 2012http://www.sustainabilityfirst.org.uk/docs/2012/Sustainability First - CLNR workshop - 9 May 2012.pdf. Sustainability First estimate that night-time units supplied for Economy 7 customers may be around 7-8% of all household units.

[16] http://www.waehrungsrechner-euro.com/euro_pfund [7.10.2013]

[17] For a description of the balancing arrangements for gas and the proposed revisions, see http://www.ofgem.gov.uk/Markets/WhlMkts/CompandEff/GasSCR/Pages/GasSCR.aspx.

[18] For a description of the balancing arrangements for electricity and the proposed revisions, see http://www.ofgem.gov.uk/Markets/WhlMkts/CompandEff/electricity-balancing-scr/Pages/index.aspx.

Balancing services

Generators and large consumers of electricity can provide balancing services to the system operator (SO). A large proportion of the SO's requirement for balancing services is met by large generators that operate within the Balancing Mechanism (BM). However, ancillary services include various mechanisms:

- Short Term Operating Reserves (STOR) – the provision of extra power through standby generation and/or demand reduction;
- Firm Frequency Response (FFR) – an automatic change in active power output or demand in response to a frequency change; and
- Frequency Control by Demand Management (FCDM) – an automatic interruption of demand customers, when the system frequency transgresses a low frequency setting on site, for example as a result of the loss of a large generation site.

Element Energy[19] report that the demand-side contributes to about 45% of STOR and 8% of FFR in GB. The STOR demand-side services are largely provided by local generation resources (embedded or back-up generation, mainly diesel and open cycle gas turbine) mitigating demand, with only 5% being load reduction[20].

Short term operating reserves (STOR)

A STOR provider must be able to offer a minimum of 3MW or more of generation or steady demand reduction (this can be from more than one site); deliver full contracted capacity within 240 minutes or less from receiving instructions from the SO; provide full contracted capacity for at least two hours when instructed; have a maximum recovery period of 20 hours; and be able to provide STOR at least three times a week.

STOR is procured via competitive tender with three tender rounds per year. The need for STOR varies across the year, the time of week and time of day, being a function of the system demand profile at that time. To reflect this, the SO splits a year into six "seasons" and specifies the periods in each day that STOR is required[21].

Firm Frequency Response (FFR)

FFR is designed to complement other sources of frequency response and delivers firm availability. The tendered service of FFR is open to Balancing Mechanism User (BMU) and Non-BMU providers thereby increasing the number of potential response providers and improving liquidity. FFR also creates a route to market for providers whose services may otherwise be inaccessible. The FFR service gives both the SO and service providers a degree of stability against price uncertainty under the mandatory service arrangements.

[19] Customer-led network revolution commercial arrangements study. Review of existing commercial arrangements and emerging best practice, Element Energy 2013

[20] For more information on FCDM, see http://www.nationalgrid.com/uk/Electricity/Balancing/services/balanceserv/freqresponse/fcdm/

[21] For more information on STOR, see: http://www.nationalgrid.com/uk/Electricity/Balancing/services/balanceserv/reserve_serv/stor/

A FFR provider must have suitable operational metering; pass the FFR 'pre-qualification assessment'; deliver minimum 10MW response energy; operate at their tendered level of demand/generation when instructed (in order to achieve the tendered frequency response capability) and have the capability to operate (when instructed) in a 'frequency sensitive mode' for dynamic response or change their MW level via automatic relay for non-dynamic response.

FFR is procured through a monthly tender. Once service providers succeed in the pre-qualification assessment and sign onto a framework agreement, they can participate in the tender process. They can tender in for a single month or multi-months. Having considered the quality, quantity and the nature of the services, the System Operator (SO) will accept the most economical tender. A successful tender then becomes contractually binding[22].

Frequency Control by Demand Management (FCDM)

FCDM is a service for the provision of reserve in contingency timescales, via a reduction in active power from demand sites. FCDM provides a route to market for the demand-side participation in the provision of reserve, where potential barriers to participation in the existing Balancing Services have been identified. The SO encourages the provision of FCDM via aggregators (or agents) in order to establish a single point of contact for any portfolio of demand sites.

Service providers must be able to deliver across a minimum of any two consecutive settlement periods; deliver a minimum 25MW from one or more than one site. In addition to these requirements, in order to allow providers the flexibility to tailor the service to their operational requirements, providers can define additional service parameters such as minimum and maximum 'On Times'. It is procured through bilateral agreement.

3. Emerging routes to market for DSF

Besides these more established routes to market, there are other routes that are currently emerging. This includes arrangements between Distribution Network Operators (DNOs) and consumers to provide DSF. Further, it is envisaged that consumers will be able to provide flexibility to enhance security of supply under the Government's proposal to establish a capacity market.

DSF arrangements between distribution network operators (DNOs) and the demand-side

DNOs can use DSF to reduce the level of peak demand on distribution networks and hence avoid or delay additional investment. They can also use DSF for managing pre- and post-fault constraints at specific points on the network. However, there remain significant challenges in developing DSF solutions. These challenges are being explored within a joint Department of Energy and Climate Change (DECC)/Ofgem/industry Smart Grids Forum, with responsibility for identifying potential barriers to smart grid implementation and to lay out possible future directions for developing solution[23].

[22] For more information on FFR, see http://www.nationalgrid.com/uk/Electricity/Balancing/services/balanceserv/freqresponse/ffr/

[23] For more information, see https://www.ofgem.gov.uk/ofgem-publications/56835/ws6-report-aug12.pdf

The Element Energy report referenced above provides a baseline from which the regulatory and commercial framework required can be assessed. Element Energy concluded that there are no regulatory conditions that would forbid DNOs to enter into arrangements with end users, utilise user storage and/or be active in local network management.

However, Element Energy highlighted two potential barriers to DNOs' participation in DSF. Firstly, there is an inherent socialisation of DSF benefits (e.g. if non-half-hourly settled customers through DSF reduce peak load all users benefit due to the methodology of the charging mechanism). Secondly, the separation of distribution from supply means that suppliers do not benefit from reductions of distribution costs (because of the aforementioned socialisation) or potential conflict in the capture of benefit may occur. For example, DNOs may wish to charge EVs at times of low demand to reduce the need for potential reinforcement. However, suppliers may want to encourage EVs to charge when they get most financial benefit (for example during periods of high wind and lower power prices).

Ofgem has pioneered the use of a network innovation funding scheme to act as catalyst for investment in the smart grid and wider electricity system. The Low Carbon Networks Fund (LCNF) [24] was established in the current electricity distribution price control period. It provides up to £500 (€592)[25] million to encourage DNOs to trial new technologies and to operate and develop commercial arrangements. The objective of these trials is to generate learning to help all DNOs understand how they can provide security of supply at value for money as GB moves to a low-carbon economy.

The largest LCNF project is a £53.6m (€ 63,5m)[26] project entitled "Customer Led Network Revolution"[27]. This is particularly relevant as its focus is on smarter grids. The project is situated in the North-East of England and it explores how new tariffs can encourage customers to be more flexible in their use of electricity. For example, changing the times at which they charge up their electric vehicles, to fit periods of lower demand. It also explores how networks can respond more flexibly to customers' needs by using more advanced voltage control devices, real time thermal rating and energy storage. It uses the data collected to consider how new technology and changes in customer behaviour could help optimise value across the energy supply chain. It also explores ways for smart meters and network operators to talk to each other. A feature of the trial is that it monitors 600 intelligent white goods such as fridges. It also involves the monitoring of 14,000 domestic customers with smart meters and a similar number of industrial/commercial customers.

In addition, there are a number of other LCNF projects that address DSF[28]. Further, a Government sponsored 'Energy Demand Research Project' tested consumers' responses to different forms of information about their energy use, including ToU[29].

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[24] For more information on the LCN Fund, see http://www.ofgem.gov.uk/Networks/ElecDist/lcnf/ftp/Pages/ftp.aspx

[25] http://www.waehrungsrechner-euro.com/euro_pfund [7.10.2013]

[26] http://www.waehrungsrechner-euro.com/euro_pfund [7.10.2013]

[27] For information on this project, see http://www.networkrevolution.co.uk/

[28] See for example the 'Capacity to Customers' project (http://www.enwl.co.uk/docs/c2c-key-documents/c2c-customer-leaflet.pdf) and the 'Low-carbon London' project (http://lowcarbonlondon.ukpowernetworks.co.uk/our-trials/demand-response/).

[29] See https://www.ofgem.gov.uk/publications-and-updates/energy-demand-research-project-final-analysis

Capacity Mechanism and DSF

The GB Government intends to introduce a capacity market to help secure the UK's energy supply[30]. It is envisaged that the SO would run an auction for capacity that creates financial rewards for providing reliable capacity to the system. The Government is keen for demand-side response to play a fair and equivalent role in the capacity market. The design of the capacity mechanism will have impacts on customers' options for providing demand-side flexibility and could affect their ability to participate in existing or potential new routes to market.

The capacity mechanism would involve a competitive central auction run four years ahead of delivery. As DSF may find it difficult to commit to providing capacity four years ahead of delivery, Government is also planning that the SO would run one year ahead auctions. Government is intending to put in place transitional arrangements and preparatory auctions for DSF in advance of the first full delivery year to help to fully exploit DSF capabilities. This includes specific annual auctions for DSF before the first delivery year. This would be for specific banded-products which are easier for DSF to provide (e.g. for delivery between 4pm and 8pm), transitioning over time to more standard load-following obligation products. Penalties for non-delivery will be lower during this transitional phase[31].

Government is also exploring whether and how permanent electricity demand reduction could participate in the capacity mechanism. Before proceeding, Government is currently exploring whether to test this via a pilot to help develop knowledge and understanding of the potential benefits and detailed design and the market appetite for such an approach[32].

4. Role of Ofgem

In response to the need for demand-side flexibility, Ofgem has developed a programme of activities to assess whether regulatory and commercial arrangements enable DSF.

Ofgem and DECC have established a Smart Grid Forum (SGF)[33] to address commercial, cultural, and technical changes, and the barriers which network companies face in making these changes. This includes consideration of barriers relating to DSF. Further, Ofgem provides input to the Government's proposal of designing a capacity market.

As described above, Ofgem has also developed the LCN Fund as an innovation funding scheme to act as catalyst for investment in the smart grid and wider electricity system. It encourages DNOs to trial new technologies and to operate and develop commercial arrangements. In addition, Ofgem has now established a 'Network Innovation Competitions'

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[30] For more information, see the Government's website on Electricity Market Reform https://www.gov.uk/government/policies/maintaining-uk-energy-security--2/supporting-pages/electricity-market-reform

[31] For details on the Government's plans and how the transitional and enduring arrangements will work, see https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/209280/15398_TSO_Cm_8637_DECC_Electricity_Market_Reform_web_optimised.pdf

[32] Government's consultation is available at https://www.gov.uk/government/consultations/options-to-encourage-permanentreductions-in-electricity-use-electricity-demand-reduction

[33] For more information on the SGF, see http://www.ofgem.gov.uk/Networks/SGF/Pages/SGF.aspx

and a 'Network Innovation Allowance' which apply the principles of the LCN Fund to all network sectors. These took effect for electricity and gas transmission and gas distribution in April 2013. They will also apply to electricity distribution when the LCN Fund finishes in March 2015. These measures encourage network companies to innovate to address issue such as moving to the low-carbon economy and delivering wider financial and environmental benefits to customers.

Ofgem has recently consulted stakeholders on DSF through our "Creating the right environment for demand-side response" consultation[34]. The consultation postulates that current arrangements do not meet three essential pre-conditions for the longer-term development of demand-side response:

1. Industry parties need to be confident that there is value for them in demand-side response which justifies the investment;
2. The value of offering different demand-side response services needs to be signalled effectively to customers; and
3. Customers need to be aware of the opportunities to provide demand-side response, able readily to access information on options and able to act.

Ofgem received 47 responses from stakeholders and will publish a response in autumn 2013.

2.7.2 Case study – Ireland

Demand-side Management on the Island of Ireland

1. The Electricity Market in the island of Ireland

The island of Ireland has a single wholesale market, the Single Electricity Market (the SEM), which is a gross mandatory pool that includes Northern Ireland and Ireland. This market is operated by an independent entity licensed by both Regulators as the Market Operator, known as SEMO (the Single Electricity Market Operator). SEMO is a joint venture between the two licensed transmission system operators (TSOs) – SONI for Northern Ireland and EirGrid for Ireland. EirGrid and SONI are both part of the EirGrid Group.

The SEM is designed, among other things, to produce the most efficient wholesale market price in each half hour and eliminate the exercise and potential for market power by generators. A Bidding Code of Practice prescribes the calculation generators use in offering their bids into the SEM. Each generator bids in its short run marginal cost and a merit order based on market bids is established for each half hour of the trading day. The TSO dispatches generators in order of lowest to highest marginal cost, and the SEM's market price (the "SMP") is the marginal cost of the marginal generator in that half-hour required to meet demand. Therefore the marginal unit earns an inframarginal rent of zero while all other dispatched plant earns an inframarginal rent of the SMP minus their short run marginal cost.

[34] For more information on the consultation and to see further updates, see https://www.ofgem.gov.uk/publications-and-updates/creating-right-environment-demand-side-response

Generators with a short run marginal cost above that of the marginal plant required to meet demand are not run (though in practice "out-of-merit" units can be run for system security reasons e.g. for reserve purposes or due to transmission system constraints although they do not receive inframarginal rent). Therefore it can be seen that generators are incentivised to increase their efficiency in order to run more often. All electricity suppliers are obliged to buy their power from the SEM at the SMP.

In relation to all SEM matters decisions are taken by the SEM Committee. The Utility Regulator is the Regulatory Authority (RA) in Northern Ireland and the Commission for Energy Regulation (CER) is the RA in Ireland. The two RAs and an independent member (with a deputy) make up the SEM Committee and each has one vote.

Generally speaking, all wholesale market issues relating to the SEM are "SEM matters" and this includes the promotion of demand-side management and response in the market. Regulatory issues which are not SEM matters are determined solely by the Utility Regulator and by CER in their respective jurisdictions.

2. Demand-side Management Benefits

In both Northern Ireland and Ireland a number of existing policies formed the basis of the SEM Committees 'Demand Side Vision for 2020', published in May 2011, which looked at international experience of demand-side management and assessed the policy responses that could be applied across the island and within each separate jurisdiction. This vision followed extensive consultation with industry and market participants.

A common challenge across the island is the planned increase in wind generation to 2020 and beyond. This is key in driving the need for demand-side activity and showing the benefits of demand-side flexibility. These benefits include:

- the potential to reduce the need for building additional plant;
- being able to increase demand in off-peak periods and especially at times of high wind availability, when increasingly there will be times at which not all of the wind on the island can be accommodated;
- the ability to move load at relatively short notice in response to changing wind conditions, in order to avoid generator part-loading and unit starts, which otherwise would increase;
- demand-side services will be increasingly valuable as thermal generation is squeezed from the merit order and the cost of provision of frequency response and similar ancillary services increases; and
- demand-side can mitigate transmission constraints, which are expected to increase.

3. Initiatives in Ireland and Northern Ireland

Initiatives in Northern Ireland and Ireland will be the basis for addressing the requirements of the Energy Efficiency Directive. These include efficiency initiatives focused on residential accommodation and business premises. In the Republic of Ireland the 'Better Energy Homes Scheme' provides financial support to home owners who invest in efficiency improvement such as insulation, efficient heating systems and solar panels while the 'Warmer Homes Scheme' promotes efficiency to electricity customers in receipt of fuel aid. In Northern Ireland the RA monitors and ensures independent auditing of the energy efficiency scheme on behalf of government, which currently spends nearly €10m per year.

Under EU Directive 2009/28/EC Ireland is legally obliged to ensure that by 2020 at least 16% of all energy consumed in the state is from renewable sources. In addition, Ireland has committed to a 20% reduction in energy consumption across all sectors of the economy, with an ambitious target of 33% efficiency savings for the public sector. The Government's energy policy framework 'Delivering a Sustainable Future for Ireland' 2007-2020 highlights the key role played by energy efficiency and confirms the importance of addressing peak electricity demand through demand-side management activities.

The distribution system is operated by ESB Networks, which is responsible for the operation, development and maintenance of the national distribution system. In addition, it holds responsibilities in relation to building, maintaining and operating the infrastructure. ESB Networks has proposed a research and development project on electric vehicles and their impact on the distribution system. The proposed project will focus on the impact of electric vehicles on the distribution system from a demand-side management perspective, along with considerations such as the impact on safety, security and reliability of the system. The CER and the DSO monitor network demands to ensure that the distribution network is prepared for changes to the system, such as for example the connection of electric vehicles, both in the medium and longer term.

The CER established a Smart Metering Project in late 2007 and trials were conducted between 2009 and 2010 with a decision published in July 2012. This decision allowed for the roll out of electricity and gas Smart Meters, which is expected to begin in 2016, following the completion of the policy and technical design, procurement, build, test and implementation phase. The goals of the National Smart Metering Programme have a set of strategic objectives including to: 1. Encourage Energy Efficiency; 2. Facilitate Peak Load Management (electricity only); 3. Support Renewable and Micro Generation (electricity only); 4. Enhance Competition and Improve Consumer Experience; and 5. Improve Network Services.

This project will assist Ireland to align with the requirements of Art 9 of the Energy Efficiency Directive 2012/27/EU in relation to providing final customers with individual meters reflecting customers' actual energy consumption and providing information on the actual time of use. CER anticipates that the use of smart meters will see an improvement in demand-side management on the part of suppliers by providing further possible opportunities for innovation in the area of energy tariffs. Suppliers are regarded as key enablers of behavioural change and energy efficiency.

The statistical evidence from the residential customer behaviour trial demonstrated that the deployment of time of use tariffs in combination with other demand-side management stimuli results in a change in electricity consumption. Specifically, the residential trial participants achieved reductions in electricity consumption, both overall usage and at times of peak usage.

In Northern Ireland the obligations in the Directive are at Member State level and as such the Department of Energy and Climate Change (DECC) will be responsible for the UK target, with Northern Ireland feeding into the DECC reporting. However the Department of Enterprise Trade and Investment Northern Ireland (DETI) is currently looking at energy efficiency provision in Northern Ireland and will in particular take due consideration of the Energy Efficiency Directive.

The Utility Regulator has sponsored a Smart Meter Trial - the first in Northern Ireland - among customers who are vulnerable to fuel poverty, which is estimated at over 40 per cent of households. The trial, beginning in 2011, indicated that customers could readily adapt and accept Smart Meters and offered the opportunity for enhanced control over energy consumption, allowing lower income customers to budget more effectively. However the trial also indicated that caution may be required against expectations that major savings will be achieved by customers who already use low amounts of electricity.

4. TSO Initiatives

Initiatives which are managed by the TSOs include the facilitation of Demand-side Units, Powersave and Short Term Active Response.

Short Term Active Response (STAR) is a scheme managed by EirGrid whereby electricity consumers are contracted to make their load available for short term interruptions. This service provides the TSO with 'reserves' that are utilised in the event of the loss (tripping) of a large generating unit and has been in operation for over 20 years.

Electricity consumers providing this service can expect 10 to 20 unplanned and instantaneous interruptions per annum of some, or all, of their load. Interruptions would typically be in the order of 5 minutes duration and no notice is given of interruptions. The cost of installing metering, communications and control equipment is paid for by customers participating in the scheme. In return for providing this service, the TSO makes payments to customers based on the energy that they make available for interruption.

The objective of the Powersave scheme, also managed by EirGrid, is to encourage large and medium sized customers to reduce their electricity demand on days when total system demand is close to available supply. In return, participating customers receive payments on the basis of kWh reductions achieved during a Powersave Event. A Powersave Event may be called any business day of the year and for any time of day. The charges and terms and conditions of these two schemes are approved by the Commission for Energy regulation.

A Demand-side Unit (DSU) consists of one or more Individual Demand Sites that can be dispatched by the TSO as if it was a generator. An Individual Demand Site is typically a medium to large industrial premises. A DSU uses a combination of on-site generation and/or plant shutdown to deliver a demand reduction in response to an instruction from the TSO. A DSU Aggregator may contract with the Individual Demand Sites and aggregate them together to operate as a single DSU. Demand sites, with or without a Maximum Export Capacity (MEC), may be eligible to register as part of a DSU. A DSU must have a demand reduction capacity of at least 4MW and the maximum demand reduction capacity of an individual demand site in an aggregated DSU is 10MW. Demand sites with greater than 10MW demand reduction capacity may register as a stand-alone DSU.

The DSU Aggregator is a third party company specialising in demand-side participation. Dispatch instructions are issued by the TSO at an aggregate level and the DSU Aggregator then coordinates the reduction from the Individual Demand Sites. By being available for dispatch the DSU will be eligible for Capacity Payments in the Single Electricity Market.

This facility can be useful to the TSO to help balance the system, such as occasions when demand is increasing and a flexible demand source could pick up when there is excess energy available e.g. during a warm night when there is plenty of wind energy on hand. Powering of electric vehicles may also become a good example of the benefits to be derived in such circumstances.

The TSOs in Northern Ireland and Ireland continue to work on development of a Smart Grid Programme that can integrate demand-side response into a system which can facultative high levels of renewables generation.

5. Changes to the Market

The SEM Committee has been aware of the benefits that demand response would have for the Single Electricity Market and has sought to identify barriers to participation in the market by industrial and commercial customers. Modifications to the rules of the Market have been introduced which address particular barriers to participation and the rule setting forum of the Market, the Trading & Settlement Code Modifications Committee, is to consider barriers to DSM identified in current modifications and the implications for demand-side participation in relevant future modifications.

The SEM Committee is also assessing the possible ways in which the SEM could be re-designed to comply with the European Target Model and while ensuring consistency with other elements of Government and regulatory policy, including demand-side participation. This market design will also be one that accommodates renewables and which should therefore provide efficient signals for appropriate investment in flexible plant and demand-side management.

6. Conclusion of the Case Study

Existing and planned initiatives on Demand-side Management have been brought together in the 'Demand Side Vision for 2020' developed by the SEM Committee. Initiatives so far have involved market based and regulatory solutions at industry and governmental level across the island. Practical research and development initiatives that will facilitate and grow demand-side participation are on-going. The electricity market on the island of Ireland faces radical changes over the next period including an increase in renewable generation, market re-design and meeting the requirements of Directive 2012/27/EU on energy efficiency. Developing Demand-side Management tools will be central in addressing all these challenges.

2.7.3 Case study – France

1. Introduction

A long history of DSF dedicated to portfolio optimisation managed by suppliers

Historically, France has been developing demand-side flexibility (DSF) through a long experience of time-based tariffs provided by the suppliers:

- **Time-of-use (ToU) tariff** whereby electricity prices are set for a specific time period on an advance or forward basis, typically not changing more often than twice a year. Prices paid for energy consumed during these periods are pre-established and known to consumers in advance, allowing them to vary their usage in response to such prices and manage their energy costs by shifting usage to a lower cost period or reducing their consumption overall.

  Launched in 1965, this tariff providing **every-day peak and off peak hours** through dedicated meters can be offered by all the suppliers and are therefore available to all end-consumers. As of today, **33% of households** (more than 50% of residential electric consumption) have chosen this kind of tariff;

- **Critical peak pricing (CPP) tariff** whereby time-of-use prices are in effect except for certain peak days, when prices may reflect the costs of generating and/or purchasing electricity at the wholesale level.

  This tariff provides **significantly higher prices 22 days a year**. Launched in 1982 and redesigned in 1996, this tariff is offered only by the former vertically integrated EDF. **At its highest it provided 6.5 GW of demand response capacity** to the system during those days: both industrial and residential consumers could switch to this tariff. Yet, this DSF option is only available with a special meter available to EDF consumers and has been in decline, and **now represents less than 2 GW**.

- Finally, EDF as well as alternative suppliers have developed **additional time-based tariffs** (Spot price strike for example) to value the DSF potential of their biggest consumers (industrial sites with smart meters).

The French Government recently started the implementation of a new work stream for the end of 2013 that should conclude on solutions to inspire a new impetus to the development of time-base tariffs provided by the suppliers. Among those discussions, the access to the CPP tariff for alternative suppliers should be addressed.

A more recent development of explicit automated demand response on the balancing mechanism

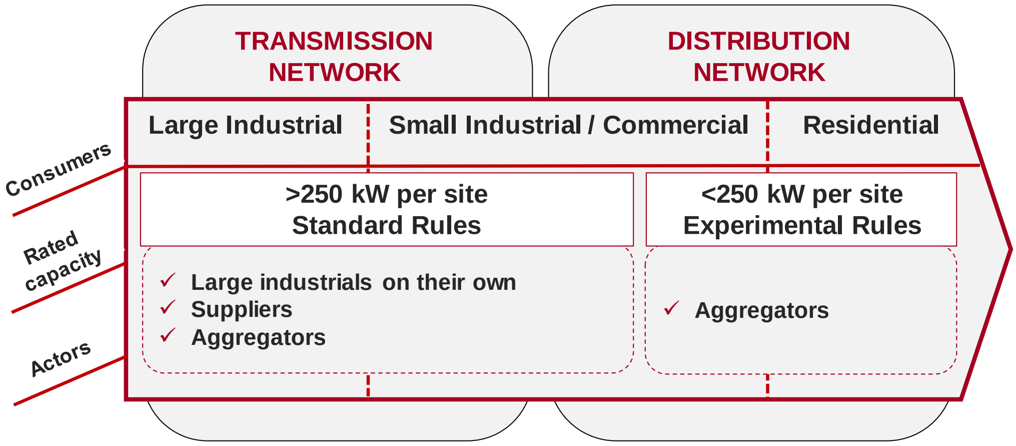

Figure 9: Explicit demand response participation on the balancing mechanism [Source: CRE]

Why explicit demand response?

Though the valuation of a consumer's flexibility has been historically ensured by its supplier, the development of demand response managed by a third party (such as the consumer itself, an aggregator, or even another supplier) ensures greater competition and fosters the development of new capacities as the supplier of a consumer does not necessarily have an interest to value demand response. This valuation of demand side resources, beyond the sole portfolio optimisation, is commonly referred to as "explicit" demand response, because it is explicitly valued directly on the market.

Alongside demand response managed by suppliers through tariffs for their portfolio optimisation purposes, CRE (the French National Regulatory Authority) has been strongly involved in promoting the development of explicit demand response on the balancing mechanism since it was launched in 2003. Consumers themselves as well as aggregators have started to value demand-side resources on the balancing mechanism since 2003. At the beginning, this explicit valuation of demand response concerned only industrial sites over 10 MW. This threshold has however been progressively lowered to enlarge the participation of demand-side resources to the balancing mechanism, by enabling for example aggregation of capacities.

What is the potential for residential demand-side flexibility before smart meters are fully rolled out?

In 2007, CRE approved an experiment to assess the potential of small industrials and residential participation to the balancing mechanism. The first bids were offered in 2010, and as of the end of the winter 2012-2013, the 100 MW upper limit was reached, showing that residential demand response could already be developed.

When it comes to aggregating the flexibility potential of thousands of households to bid on the markets and participate to balance the system, reliability appears to be a greater challenge than usual: how to be sure that the MWs of demand-side flexibility have been activated? Without a massive deployment of smart meters, the real time measure of the consumption level that is needed to certify the demand response actions has to rely on alternative methodologies.

In France, Voltalis has developed its own boxes able to communicate a real time measure of some electric devices. The company is therefore able to order and control real time curtailments to value the flexibility of the residential consumers. Without any meter installed by the DSOs to provide a certified level of consumption, the data produced by Voltalis' boxes has to be used for real-time measuring of the consumption. This case raised a key issue of which data could be used to certify demand response actions.

2. On-going Work

Towards a full participation of demand-side resources to the energy markets

In 2012, work started to design a mechanism to enable access to the consumers' flexibility in order to value explicit demand response on the wholesale markets.

A new law published in April 2013 clarified the legal framework for the development of demand-side resources on the energy and balancing markets. CRE has proposed a decree to the Ministers that sets out the architecture to allow for the participation of demand resources to the energy and balancing markets, ensuring a level playing field with generation.

New rules to allow experimental explicit demand response by third parties on the energy markets are under preparation and should be approved by CRE to start before Winter 2013-2014.

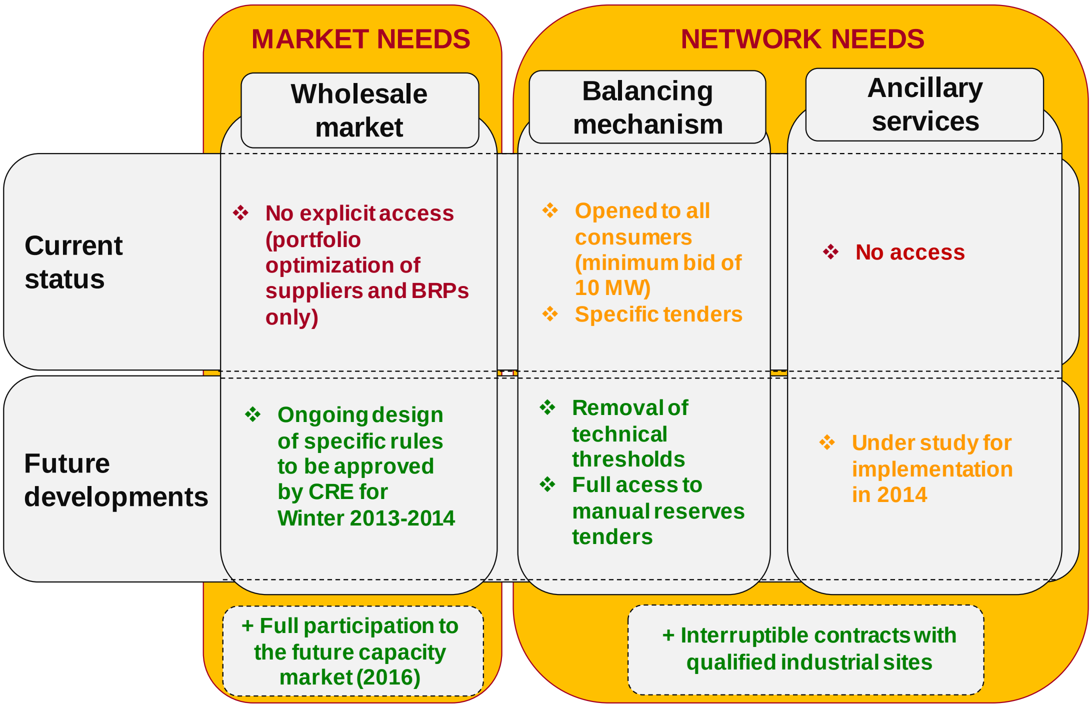

Figure 10: Summary of demand side resources participation in France in 2013 [Source: CRE]

Mechanisms to remunerate the capacity value of demand-side flexibility

Since 2008, RTE (the French TSO) has organised tenders (modalities approved by CRE) dedicated to demand response capacities to form a reserve used when tension occurs on the balancing mechanism (price spikes or low security margin level). These tenders offer a steady remuneration to the selected capacities: it has proven to be a strong incentive to develop new capacities that now roughly amount to 1 GW on the balancing mechanism.

During the winter 2012/2013, CRE also approved an experimental tender on the balancing mechanism for capacities – both generation and demand – located in Brittany that could be used to manage local congestions that regularly occur in this region in winter. With a lower minimum bid level (1 MW instead of 10 MW) and aggregation possibilities, new capacities have been able to emerge.

Demand resources can also partly participate in tenders for the balancing reserves alongside supply resources. In the framework of a market design reform concerning ancillary services, the participation of demand-side resources to ancillary services is also considered.

- ✓ Around 1 GW of available DR capacity in 2012
- ✓ Vigourous development of small scale DR (residential)
- ✓ Capacity tenders since 2008:
  - 100 MW in 2008-2010
  - 230 MW in 2011
  - 392 MW in 2012
  - Up to 700 MW in 2012/2013

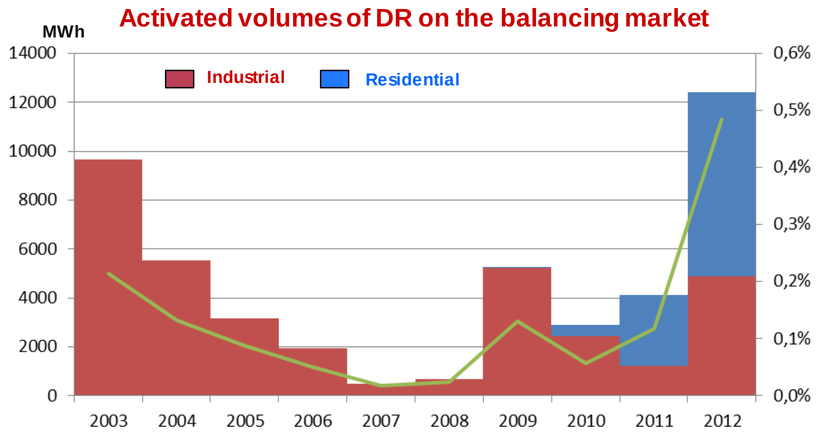

Figure 11: Demand response development on the balancing mechanism [Source: CRE]

Demand-side resources will also be able to participate in the future capacity market that is currently being designed and scheduled to start in 2016. The market should be designed in order to foster the participation of demand-side resources to ensure generation adequacy especially during consumption peaks. The new law published in April 2013 specifically states that at equal costs, the mechanism will have to favour demand-side resources rather than generation. Implicit valuation as it has been done until now by suppliers will contribute to lower their capacity obligations, while explicit valuation will also be possible through the certification of demand response capacities.

Experience of the capacity tenders on the French balancing mechanism show that the major part of demand response's value comes from the capacity side more than the energy. Also, fixed capacity incomes provided by such mechanisms appear to be essential to enable the development of those capacities.

3. Main Challenges

Major technical issues still to be addressed

Determination of the baseline (level of consumption that "would have been" without demand response) is among one of the most important issues to tackle in order to reach a full participation of demand-side resources to the energy markets. Development of demand response will not be achieved if reliable certification process cannot be implemented. As of today, the method that is used to certify the level of demand response activated on the balancing market is not adapted to all energy markets and does not allow the participation of all resources. Additional capacities from industrial sites with specific consumption patterns or residential consumers with no smart meter will therefore be able to emerge if new methodologies (which will require testing) are able to certify their demand response actions.

Several methods will be tested during the experimental phase of DR participation to energy markets.

For instance, Distribution System Operators (DSOs) are currently working on a statistical method based on samples equipped with smart meters to assess the consumption of thousands of consumers without having to equip them all with smart meters.

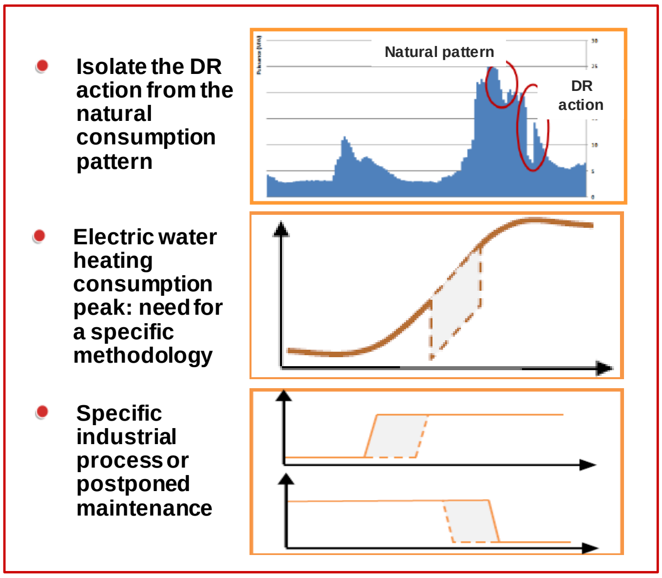

Figure 12: A need for sophisticated and adapted control methodologies [Source: CRE]

Technical thresholds that limit access to the balancing reserves or to the market will also have to be removed in order to value the full potential of demand-side resources (minimum bid, size requirement to participate, annexation to a specific balancing responsible party, network connection etc.). CRE is strongly involved in this work, together with the Transmission System Operator (TSO), the DSOs, and the market players.

Specific issues regarding resources connected to the distribution networks

In the future, the major part of new demand-side resources that will participate in the markets will be located on the distribution network. DSOs will therefore play a key role in the management of those resources, and important work will have to be undertaken in order to take full advantage of the value of local demand-side participation for the network.

A significant value of demand-side flexibility regarding residential consumers may indeed be found in the management of local constraints and possibly when considering local network reinforcement. Yet, this potential cannot be achieved as of today as DSOs do not have any local balancing mechanism. The local management of demand-side resources has raised some specific issues and questions that will have to be addressed.

4. Conclusion

Important challenges remain, but the full participation of demand-side resources to the markets alongside supply, in compliance with the Energy Efficiency Directive, is on track. Several projects that should be launched or initiated in the coming months will strongly improve the opportunities for those resources both on the energy and (future) capacity markets. From individual residential consumers to the largest industrial sites, demand-side resources provide indeed a large range of services to the electricity system that will contribute to enhance long term security of supply as well as increase the needed flexibility to balance energy markets with a growing level of renewable sources output.

2.7.4 Case study – Hungary

In Hungary, electricity universal service providers (regulated tariff suppliers) have to offer their customers one ("A1"), two ("A2" in general, "A3" for public institutions) or 2+ ("B") tariffs according to time periods of the day (e.g. peak and off-peak)[35]. This is **price-based demand response (DR) with time-of-use tariffs**. Nevertheless, a better but more sophisticated solution would be real-time pricing with minute or hourly pricing (a prerequisite is the installation of smart meters).

"A2" and "A3" pricing can only be used if electricity consumption can be metered separately in peak and off-peak periods. "B" tariffs are used for load control purposes, in the form of **ripple control** for electric boilers and space heaters. Ripple control is the remote control of a switch by electrical impulses which is managed by the DSO, but has to also be in line with the TSO's (MAVIR) electricity system balancing goals. In peak times, DSOs can switch off these electric devices, but the aforementioned Decree states that these devices have to receive electricity at least 8 hours a day (minimum 7 hours in summer time). From these hours a maximum of 6 hours (or 5 hours) can be in the off-peak period and operation during peak-time has to be at least 30 minutes regarding each operation period. Consumers are rewarded for this **direct load control** service with lower tariffs for designated periods. (This illustrates **incentive-based DR**.) With this tool, approximately 1500-1800 MW capacity can be shifted on the demand-side from peak to off-peak hours (this is approximately a quarter of the total 6560 MW peak-load in 2010), which means in practice around 600 GWh shifted consumption a year (approximately 2% of total net electricity consumption).

Furthermore, two large consumers are participating in **reserve capacity tenders** organised by the Transmission System Operator (TSO) (MAVIR). They bid into the ancillary services market to provide operating reserves, which means that they reduce consumption if necessary, and receive payments for providing the service from the TSO.

As Hungary will have to implement the provisions of the **new Energy Efficiency Directive** (2012/27/EU), it will be necessary to elaborate and develop new energy efficiency incentives by the government and authorities (e.g. Article 7: Energy efficiency obligation schemes).

As part of the preparation for the above mentioned task, the Hungarian Energy and Public Utility Regulatory Authority (HEA) launched a formal **cooperation with RAP (Regulatory Assistance Project) of the United States of America**. Its purpose is to develop alternatives (providing incentives to Distribution System Operators (DSOs)) for addressing revenue losses resulting from energy efficiency programs (in which the DSOs support the end-users' energy efficiency programs), including lost margin recovery mechanisms, incentive regulation, and **decoupling of the distribution rate**.

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[35] 4/2011, Decree of the Ministry of National Development

For the above reason, a workshop was held in Budapest in February 2012. During the workshop Jim Lazar (expert of RAP) introduced the experience of implementing the energy efficiency models of RAP in other countries, and introduced the so-called **decoupling model**.

He described decoupling as one of the most effective policies for Hungary, and presented an example mechanism for an illustrative Hungarian electricity distributor. The workshop focused primarily on the electricity sector; however, decoupling could be implemented for gas and district heating companies as well.

In the decoupling model the level of the end-user price of energy is determined in such a way that ensures the justified income of DSOs regardless of the volume of the distributed energy (**decoupled rate**). It means that the DSOs will not be interested in increasing the distributed volume or in keeping it at a certain level. This incentivises the reduction of energy demand by encouraging the DSO to improve the efficiency of its infrastructure and employ demand-side management practices.

For more information please visit the HEA website.

Network efficiency:

In Hungary, the HEA is responsible for the regulation of network tariffs. In this context, the HEA determines the highest acknowledged value of technical network losses and is continuously trying to reduce this value. For example, if the DSO's network has a technical loss above the average, the HEA will request an average value in the next tariff regulatory period. This measure is intended to improve network efficiency.

Smart metering pilot projects:

DSOs started their joint smart metering pilot project in summer 2012 with the installation of 20000 electricity smart meters in households and small enterprises (+3000 smart gas and 1000 district heating and water meters) in 550 Hungarian settlements. The aim of the project is to examine the technical and economic feasibility of smart metering. The project will cost 1 billion HUF (approximately 3.6 million EUR). Consumer behaviour will be assessed in late 2013 and the project itself will end in March 2014. Participating households were selected on a statistical basis but there is no obligation to take part in the project. The supply companies bear the costs of installation of smart meters and the operation of the metering-system; households receive the equipment at no cost.

Within the scope of the project described above, a multiutility smart metering pilot project was launched jointly by the electricity, gas, district heating and water supply companies of the capital of Hungary (Budapest). This is a special project as there is integration between smart meters of the four public utility services. This way the possibility of so called smart homes and the introduction of new, more flexible tariffs can be examined.

Smart meters have been installed since September 2012; until 2013, 8000 meters will be installed to meter electricity consumption, 1000 each for gas and water and 500 for district heating. Smart meters will start to deliver data from 2013, and outcomes will be examined in late 2013/early 2014 jointly with the HEA.

Energy suppliers are working together with telecommunication companies in their smart metering projects. (For example E.ON with Hungarian Telekom, or EDF DÉMÁSZ with IBM.)

The TSO (MAVIR) has also announced to launch a smart metering pilot project in 2013 with a far bigger budget than the DSOs' of 10.5 billion HUF (38 million EUR) and involving 190000 households (100 thousand in electricity and 90 thousand in gas) until 2014 (DSOs: only 20000). The project would last 2 years and would be financed through CO_2 quota auction revenues (this has been already approved by the Commission). Based on a new formulating concept the meter itself would be part of the distribution grid but the data would be collected centrally by the TSO.

VPP-Redbox smart grid solution

VPP, the first Virtual Power Plant Operator in Hungary (active on the market for 2 years now) has launched a new retail power product called Redbox in June 2013. The VPP consists of a Control Centre and 34 co-generation power plants (with an installed capacity of 143 MW at the beginning of 2013) operating locally and separately in the electricity network, but connected to the same IT-system. This way the system is capable of:

- secondary regulation of outstanding quality in power generation,
- meeting the consumer portfolios in a precise and reliable way,
- assuring the generation profiles comply with the consumption needs in heat energy generation,
- generation, regulation and energy supply (24/7).

In this way the VPP's power generation can be aligned with the power consumption needs of clients and a better power price can be offered to them. The service is offered to small and medium-sized enterprises (SMEs) (from 20 MWh yearly consumption) that provide their consumption patterns to VPP, who in turn provide a customised offer. The SMEs buy their electricity directly from the Virtual Power Plant, without any intermediate partners, as this also makes the power offered to them cheaper.

The VPP-Redbox model is a flexible solution for the alignment of power production and consumption. However, with the future development of smart meters and grids in Hungary, the potential benefits of such solutions are likely to increase.

3 Current regulatory position

The following Section provides a high level summary of the main findings of the internal NRA survey. Eighteen responses out of a possible 31 (EU28, Iceland, Switzerland and Norway) were received so the survey responses are not fully representative of all NRAs. Although responses were not exhaustive, the process has provided considerable insight into the regulatory position in many countries.

3.1 Current experience of demand-side flexibility within countries/NRAs[36]

The survey shows that there was significant diversity of experience of demand-side flexibility across EU Member States. The table below records the key experiences that NRAs self-reported as part of the survey (recognising that this is not a complete picture). An attempt has been made to categorise the different forms of demand-side flexibility in operation across different Member States, however, this attempt should be considered to be illustrative only as there is significant crossover between categories and definitions differ between countries. Where there has only been recent experience clearly identified (less than 5 years) the suffix (st) is used. Cyprus indicated that they have had no experience with demand-side flexibility.

Experience	Country
Time-of-use tariffs[37]	Austria, Belgium, Finland, France, Germany, Great Britain, Greece, Hungary, Italy, Lithuania, Portugal, Romania, Slovenia, Spain
Interruptible Contracts[38] and contractual solutions - large industrial and commercial users[39]	Austria, Belgium, France, Germany[40], Great Britain, Hungary, Ireland, Italy, Norway, Portugal (st), Romania, Slovenia, Spain, Sweden, The Netherlands
Remote reading[41] (e.g. Ripple Control technology, tele-switching, automated generation control for big production installations by DSO, etc.)	Austria, Belgium, Great Britain, Hungary, Italy, Sweden
Hourly meter reading	Italy, Norway, Sweden

[36] Prior to the introduction of the Energy Efficiency Directive

[37] Definition: Energy tariffs that charge different prices at different times of the day, week, month or year. [Source: Creating the Right Environment for Demand-Side Response, Ofgem 2013 consultation]

[38] Definition: The term 'Interruptible load' can be defined as 'program activities that, in accordance with contractual arrangements, can interrupt consumer load at times of seasonal peak load by direct control of the utility system operator or by action of the consumer at the direct request of the system operator. It usually involves commercial and industrial consumers. [Source: http://www.teachmefinance.com/Scientific_Terms/Interruptible%20load.html#ixzz2gfKA1kHG]

[39] Definition: A bilateral contractual arrangement between the DSO/TSO and large scale users to provide system benefits and reduce reinforcement requirements

[40] Especially in the industrial branch

[41] Definition: Metering value read remotely and stored, with provision to relevant service providers. The meter values are registered through a standard interface at a predefined time schedule or upon request. This includes export metering (i.e. provision of consumption and injection data and exported net flows).[C11-RMF-36-03]

Experience	Country
Automatic meter reading[42] (industrial)	Belgium (st), Germany[43], Italy, Lithuania, Portugal, Spain
Government/NRA/DSO co-ordinated Smart Metering Pilots, Plans, Deployment[44]	Austria, Belgium (st), Finland, France, Germany, Great Britain, Hungary, Italy, Lithuania, Luxembourg, Portugal, Spain, The Netherlands
Demand-response aggregator services[45]	Belgium, France, Great Britain[46], Ireland, The Netherlands
Virtual Power Plant (VPP) installed and controlled by the distribution companies[47]	Germany, Slovenia (st), The Netherlands
Use of DSF in Short Term Operating Reserves[48], Frequency Response Services[49]	Finland (st), France, Great Britain, Sweden[50]
Use of DSF for congestion management and balance maintenance[51]	France, Italy[52], The Netherlands

Figure 13: Main commercial demand-side arrangements recorded by country [Source: CEER]

[42] Definition: Automated meter reading (AMR) is a technology used in utility meters for collecting the data that's needed for billing purposes. AMR, which works by translating the movement of the mechanical dials on a meter into a digital signal, does not require physical access or visual inspection. [Source: http://whatis.techtarget.com/definition/automated-meter-reading-AMR]

[43] Industrial and middle-sized companies.

[44] Definition: Advanced metering systems that support secure bidirectional communication upstream and downstream and allows advanced information and management and control system for consumers and service providers. [Source: EC, 2009b, Shift, Not Drift: Towards Active Demand Response and Beyond, Florence School of Regulation Think report 2013]

[45] Definition: A third party intermediary specialising in coordinating or aggregating demand response from individual customers to better meet industry parties' technical requirements for specific routes to market. [Source: Creating the Right Environment for Demand-Side Response, Ofgem 2013 consultation]

[46] Via Demand Management (DM), a service for the provision of reserve in contingent timescales, via reduction in active power from demand sites. National Grid encourages the provision of DM via aggregators (or agents) in order to establish a single point of contact for any portfolio of Demand sites (although it should be noted that aggregators provide a wider set of services than simply demand management services for the TSO).

[47] Definition: A Virtual Power Plant (VPP) aggregates the capacity of many diverse distributed energy resources (DER). It creates a single operating profile from a composite of parameters characterising each DER unit and can incorporate the impact of the network on aggregate DER output. A VPP is a flexible representation of a portfolio of DER that can be used to make contracts in the wholesale market and to offer services to the system operator. [Source: Virtual Power Plants in Real Applications Pilot, Demonstrations in Spain and England as part of the European project FENIX, Martin Braun Institut für Solare Energieversorgungstechnik (ISET)]

[48] Definition: The System Operator can use demand-side response through the following routes to market (but can balance the market in other ways too): STOR – the provision of additional power ahead of day to deal with unforeseen demand increases or generation unavailability STOR can be provided through DSM. [Source: Creating the Right Environment for Demand-Side Response, Ofgem 2013 consultation]

[49] Definition: Frequency Response Services – is designed to complement other sources of Frequency response and is procured by tender from DSM providers [Source: National Grid].

[50] Sweden has experience of Short Term Operating Reserves but not Frequency Response Services.

[51] Definition: congestion management can be considered any systematic approach used in scheduling and matching generation and loads in order to manage congestion. [Source: Congestion Management Requirements, Methods and Performance Indices, Consortium for Electric Reliability Technology Solutions]

[52] In Italy demand can also participate in the Balancing Market; technical regulations are being finalised.

3.2 Initial findings from internal NRA survey

Support for demand-side flexibility within legislative provisions

Although national legislative frameworks often provide indirectly for demand-side flexibility (e.g. via cost efficiency obligations) the survey identified only a small number of countries where demand-side flexibility was considered to be explicitly mandated (Austria, France, Germany, Hungary and Portugal). Clearly, the adoption of the Energy Efficiency Directive will change this situation over time, but transposition rates will vary between Member States.

Specific regulatory roles (predominantly pilot/R&D based)

Examples of specific functions carried out by the regulators include the investigation of demand-side flexibility in a ‘smarter grids’ framework (Belgium), pilot projects on smart grids, electric vehicles and electricity storage (AEEG in Italy), the initiation of the involvement of consumers in reserve capacity tenders (Hungarian Energy and Public Utility Regulatory Authority) and the offer of real-time wholesale prices for retail users (Netherlands).

Use of network tariffs and regulation in delivering demand-side flexibility

In the context of Article 15.4 of the Energy Efficiency Directive (2012/27/EU) 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.

Austria, France, Hungary, Great Britain, Italy, Norway, Portugal, Slovenia and the Netherlands all fell in this category. Hungary noted that they had a role in determining the highest acknowledged value of technical network losses and is continuously trying to reduce this value. For example, if the Distribution System Operator’s (DSO’s) network has a technical loss above the average, it would request an average value in the next tariff regulatory period. The same scheme for losses control is also applied in Lithuania. In Italy AEEG has recently opened an extensive investigation to reform the current network tariff regulation for domestic customers in order, *inter alia*, to eliminate possible barriers to demand-side flexibility (e.g. via more cost-reflective tariffs)

Cyprus, Denmark, Finland and Luxembourg had no experience with network tariffs and regulation to promote energy efficiency improvements prior to the Energy Efficiency Directive.

Finland, Romania, Slovenia, Lithuania and Spain have relatively limited experience with network tariffs and regulation to promote energy efficiency improvements. Their experiences include the participation of demand-side flexibility with auxiliary reserves, obligations / incentives for the Transmission System Operator (TSO) and distribution operators to reduce their losses, TOU and tariff of last resort.

Broadly, national legislation was often seen as the driver of the uptake of tariffs and regulation. However, only Portugal and France stated that they had a legal mandate. For example, Article L. 341-4 of the French Energy Code provides a legal mandate to introduce time differentiated network tariffs. This Article requires that network tariffs should ensure consumers are incentivised to consume less during hours for which total consumption is the highest.

Absence of smart metering – a key barrier to demand-side flexibility

In addition to the barriers identified in the case studies, the absence of advanced metering was identified as a key barrier to the provision of demand-side flexibility services. In particular, Belgium identified that a legal framework for smart meters is missing in the Flemish region and Norway suggested that complete installation of smart metering (Advanced Metering Service or Advanced Metering Infrastructure) is required but in Norway this will not be achieved until 2019. Austria considers the introduction of smart meters as one step towards achieving customer awareness in energy efficiency and likely as one of many necessary steps to promote some kind of demand response schemes in the future, especially for end consumers, via providing enough meter data.

Nevertheless, the introduction of smart meters alone cannot be seen as a key factor to establishing demand response systems, since a variety of different measures linked to it require much more advanced technologies (i.e. smart homes) which are not connected or based on a smart meter system itself. Smart meter systems merely have the function to provide meter readings/data frequently enough to support advanced tariff schemes, possibly also in connection with demand measures.

Role of current market structures in enabling/constraining demand-side flexibility

Cyprus indicated that their current market structures do not allow demand-side flexibility. Luxembourg does not currently explicitly foresee demand-side flexibility, but the market structure does not impede its implementation.

In France, demand-side flexibility can either be offered to market arrangements through balancing responsible parties' internal portfolios' arrangements, or directly through wholesale markets[53]. In Italy, demand participation can also occur in the day-ahead market.

In Hungary, two large consumers are participating in reserve capacity tenders organised by the TSO (MAVIR). Large industrial consumers may participate in the balancing markets of Norway and Romania. As indicated previously, in Great Britain the market structure allows STOR, Frequency Response Services and Demand Management, and in Italy demand (load) can participate in both the day-ahead market (MGP) and in the dispatching services energy market (MSD). However, so far, the elasticity of demand has been very limited, possibly partially due to the low level of thermal consumption in the country as well as to the 3 kW power limitation for households, in place since the 1970s.

In summary, thirteen NRAs provided specific comments on the extent to which current market structures allowed for the participation of demand-side. Several responses (Denmark, Finland, France, Hungary, Spain and Sweden) emphasised the engagement with larger customers/consumers, and France and Ireland emphasised the evolving role of aggregators within the market.

[53] The rules allowing a direct participation of DSF on the wholesale markets are still being designed. The go-live of the experimental phase is expected for the winter 2013-2014.

Emerging factors (enabling/constraining) affecting demand-side flexibility

The survey investigated a number of enabling / constraining factors regarding DSF, for example, seeking to identify views on the minimum size of take up of smart metering to allow full participation of demand-side flexibility in energy markets. Responses included:

- There are minimum sizes for the provision of balancing services in Great Britain.
- In relation to smart meter/consumption data being made available to market participants (such as aggregators), some countries indicated that information would only be released to the market if allowed by consumers (Austria, Norway) while in other countries these issues are still in the process of being resolved.
- Great Britain, Ireland and Spain indicated that a form of capacity mechanism would be maintained or introduced in the future and indicated that they should be open to demand-side resources.
- Greece highlighted the unique nature of demand-side flexibility in non-connected systems (such as the Greek islands). Due to these special circumstances, the prioritisation, rationale and potential for demand-side flexibility may be very different than under more ‘networked’ conditions.

4. Questions for Public Consultation and Next Steps

CEER hopes that those stakeholders with a particular interest in demand-side flexibility arrangements (TSOs, DSOs, market participants, consumers etc.) will participate actively in the consultation. We also welcome responses from groups that are developing and discussing issues in the context of the internal electricity market, such as the Florence Forum.

CEER also notes that these issues are not exclusive to Europe. CEER will therefore consider the merits of including international examples in its final Advice, including seeking views from the International Confederation of Energy Regulators (ICER).

CEER invites all stakeholders interested in the regulatory implications of integrating demand-side measures into European electricity markets to respond to this consultation, both in general and in relation to the questions below.

The deadline for responses is **20 December 2013** and instructions for responding are provided on **page 3**. Respondents are therefore invited to reply and provide comments on the following questions:

Consultation questions

1) **What do you see as the main opportunities and benefits for demand-side flexibility in existing/future markets and network arrangements?** Please identify, describe and prioritise the opportunities and benefits.

2) **What do you see as the main barriers (e.g. legislative/market/regulatory) to the emergence / functioning of demand-side flexibility?** Please identify, prioritise and explain the key barriers and highlight any essential preconditions[54].

3) **In what way will the implementation of the Energy Efficiency Directive (EED 2012/27/EU) affect your organisation/involvement with demand-side flexibility arrangements?** Please make particular reference to Articles 15.4, 15(8) and Annex XI in your response (summarised in Appendix 4).

4) Have you undertaken/are you aware of **studies examining the cost-benefit of demand-side flexibility measures** (for your country or for your organisation), and/or their cost-effectiveness relative to other measures? What were the results? (Please upload the study here or provide a link; if possible in English.)

5) **Are there any other/wider considerations which we should take into account?** For example, policy developments and technical standards.

[54] These include, for example, (1) a minimum scale of take up/demand for enabling technologies (e.g. electric vehicles, heat pumps, (2) competitive access to consumption data (from smart meters) to allow a competitive market in services to emerge and (3) Flexible distribution networks to manage local demand shifting, etc.

Following the consultation and public workshop on 18 November, regulators will develop an Advice paper on matters related to demand-side flexibility, to be brought forward in Spring 2014. This work will also inform the proposals being developed as part of the ACER "The Bridge" project on the future regulatory framework for Europe's electricity and gas markets.

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. A key objective of CEER is to facilitate the creation of a single, competitive, efficient and sustainable EU internal energy market that works in the public interest.

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.

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.

Annex 2 – Glossary[55] and list of abbreviations

Term	Definition
ACER	Agency for the Cooperation of Energy Regulators
AMI	Advanced Metering Infrastructure
Ancillary services	Services necessary for the reliable transmission of electricity between parties, e.g. scheduling and dispatch, load following
Balancing services	Broadly speaking, the electricity network needs to remain in balance (with levels of supply equalling levels of demand). This is currently managed via a number of mechanisms and the involvement of the TSOs, DSOs and energy suppliers
BRP	Balance Responsible Party
CEER	Council of European Energy Regulators
CPP	Critical Peak Pricing
DSO	Distribution System Operator
Energy Efficiency Directive (EED)	Directive 2012/27/EC - a common framework of measures for the promotion of energy efficiency within the EU in order to ensure the achievement of the headline target on energy efficiency
ENTSO-E	The European Network of Transmission System Operators for electricity
ESCO	Energy Services Company (which may or may not also be an aggregator)
MS	Member State
NRA	National Regulatory Authority, as per the role set out in the Electricity and Gas Directives in the 3rd Energy Legislation Package
RES	Renewable Energy Sources
Static tariffs	Energy tariffs that charge the same price per unit of electricity irrespective of external factors (e.g. capacity of the system)
TSO	Transmission System Operator
3rd Package	The Electricity Directive (2009/72) (concerning common rules for the internal market in electricity), the Gas Directive (2009/73) (concerning common rules for the internal market in natural gas), the Gas Regulation (Reg 715/2009), the Electricity Regulation (Reg 714/2000) and the ACER Regulation (Reg 713/2009)

[55] Please note that there are further definitions embedded in footnotes throughout the document.

Annex 3 – Demand-side flexibility 'pilot' studies and initiatives

There are currently a wide range of activities on DSF pilots amongst member states, mostly related to smart grids.

The following table has been derived from the internal NRA survey information so should be considered an incomplete record.

Member State	Nature of pilot(s)	Links/fuller description
Austria	Smart Grids, Smart Meter	Smart grids play an important role in making a successful transition to sustainable energy. The Smart Grids Model Region Salzburg (SGMS) shows how intelligent electricity networks can look in practice through comprehensive research activities and demonstrations. In applying the philosophy that "the whole is more than the sum of its parts", SGMS has endeavoured to combine the findings of the numerous individual projects into a systematic whole: Smart Infrastructure Salzburg. www.smartgridsalzburg.at (available in English)
Belgium	Smart Grids	www.linear-smartgrid.be/?q=en The pilot by the DSOs: http://www.eandis.be/eandis/pdf/21120E3.DOC_DataId_8789831_Version_1.pdf
Cyprus	Smart Grids	Net metering with the use of Photovoltaic systems with smart meters.
Denmark	DSF	Time differentiated tariffs and/or agreements on regulation of large companies. http://www.dongenergy-distribution.dk/SiteCollectionDocuments/eFlex/The%20eFlex%20Project-low.pdf http://www.dongenergy.com/en/innovation/developing/pages/eflex.aspx
Great Britain	Energy Demand Research (consumer behaviour) and the Low Carbon Network Fund	www.ofgem.gov.uk/Sustainability/EDRP/Pages/EDRP.aspx Energy Networks Association Portal (containing details of the LCNF and IFI projects):http://www.ena-eng.org/smarter-networks/index.aspx
Greece	Smart metering	A new pilot project for the installation and monitoring of 160.000 smart meters will be initiated shortly (the Bidding Documents are currently under public consultation) by the Greek DSO, aiming at investigating the benefits of large scale introduction of smart metering. http://www.deddie.gr/Default.aspx?id=60970&nt=18&lang=2
Hungary	Smart metering	Pilot including multi-utility smart metering, please see case study in Section 2.7.4
Ireland	Demand-side Units Smart meters	www.eirgid.com/operations/demonstration projects
Italy	Smart grids, Electric Vehicles (EV) charging infrastructure, Storage, Multiservice smart meters	Selected smart grids pilots benefit from a 2% extra WACC in addition to the standard rate of return on capital, for 12 years. Pilots on EV recharging infrastructure are open to both DSOs and third parties (charging service providers). Storage pilots include both energy and power storage (see the Status Review of the Implementation of the Guidelines of Good Practice for Storage System Operators as described in the CEER 2013 work programme). More recently the framework to select multiservice smart meters demonstration projects has been defined.
Norway	Smart Grid	www.sintef.no/home/SINTEF-Energy-Research/Xergi/Xergi-2012/Artikkel11/
Portugal	DSF	The revision of the Tariff Code establishes that the network operators (TSO and DSOs) shall present a study to ERSE on the

Member State	Nature of pilot(s)	Links/fuller description
	Smart grid	viability of introducing dynamic tariffs. For example the DSO EDP Distribuição has a pilot test on smart grids called Inovgrid (http://www.edpdistribuicao.pt/pt/rede/InovGrid/Pages/InovGrid.aspx)
Spain	CNE Smart Grids WG Gad project	This WG was convened by CNE (now CNMC) and gathered representatives from the industry in order to prepare proposals for DSF such as tariff review, price signals, information management and exchange, etc. Government-led project on active and efficient electric consumption management for households http://gad.ite.es/index_en.html
The Netherlands	Smart grids	http://www.agentschapnl.nl/content/factsheets-12-proeftuinen-intelligente-netten-juli-2013 http://www.powermatchingcity.nl/site/pagina.php PowerMatching City is a living lab demonstration of a future energy system. In PowerMatching City the connected households have smart appliances that match their energy use in real time, depending on the available (renewable) generation.

Annex 4 – Relevant extracts from the Energy Efficiency Directive

On 25 October 2012, the EU adopted the Directive 2012/27/EU[56] on energy efficiency.

This Directive sets out an EU-wide framework for the promotion of energy efficiency in order to ensure the achievement of the Union's 2020 20% headline target on energy efficiency and to establish a basis for further energy efficiency improvements beyond that date. The provisions within the Directive seek to remove barriers in the energy market and overcome market failures that impede efficiency in the supply and use of energy.

In summary (see table below for the full requirements), NRAs are required to:

- Remove incentives which hamper demand-side flexibility in balancing services
- Encourage demand-side participation in wholesale and retail markets
- Define technical requirements of balancing markets which do not discriminate against demand-side services
- Enable a role for intermediaries /aggregators
- Complete CBA including consideration of demand-side flexibility measures
- Reflect demand-side cost-savings in network tariffs
- Support dynamic pricing for final customers in network or retail tariffs
- Report on progress with enabling demand-side flexibility in National Energy Efficiency Action Plans.

Energy Efficiency Directive	Relevance to NRA competencies
Article 15.4	MS shall ensure the removal of those incentives in transmission and distribution tariffs that are detrimental to the overall efficiency (including energy efficiency) of the generation, transmission, distribution and supply of electricity or those that might hamper participation of demand response, in balancing markets and ancillary services procurement.
Article 15.8	All NRAs 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. Subject to technical constraints inherent in managing networks, Member States shall promote access to and participation of demand response in balancing, reserve and other system services markets, *inter alia* by requiring national energy regulatory authorities or, where their national regulatory systems so require, transmission system operators and distribution system operators in close cooperation with demand service providers and consumers, to define technical modalities for participation in these markets on the basis of the technical requirements of these markets and the capabilities

[56] Directive 2012/27/EU on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC [OJ L315 p.1]

Energy Efficiency Directive	Relevance to NRA competencies
	of demand response. Such specifications shall include the participation of aggregators.

Energy Efficiency Directive	ANNEX XI
Energy efficiency criteria for energy network regulation and for electricity network tariffs	1. Network tariffs shall be cost-reflective of cost-savings in networks achieved from demand-side and demand- response measures and distributed generation, including savings from lowering the cost of delivery or of network investment and a more optimal operation of the network. 2. Network regulation and tariffs shall not prevent network operators or energy retailers making available system services for demand response measures, demand management and distributed generation on organised electricity markets, in particular: (a) the shifting of the load from peak to off-peak times by final customers taking into account the availability of renewable energy, energy from cogeneration and distributed generation; (b) energy savings from demand response of distributed consumers by energy aggregators; (c) demand reduction from energy efficiency measures undertaken by energy service providers, including energy service companies; (d) the connection and dispatch of generation sources at lower voltage levels; (e) the connection of generation sources from closer location to the consumption; and (f) the storage of energy. For the purposes of this provision the term ‘organised electricity markets’ shall include over-the-counter markets and electricity exchanges for trading energy, capacity, balancing and ancillary services in all timeframes, including forward, day-ahead and intra-day markets. 3. Network or retail tariffs may support dynamic pricing for demand response measures by final customers, such as: (a) time-of-use tariffs; (b) critical peak pricing; (c) real time pricing; and (d) peak time rebates.