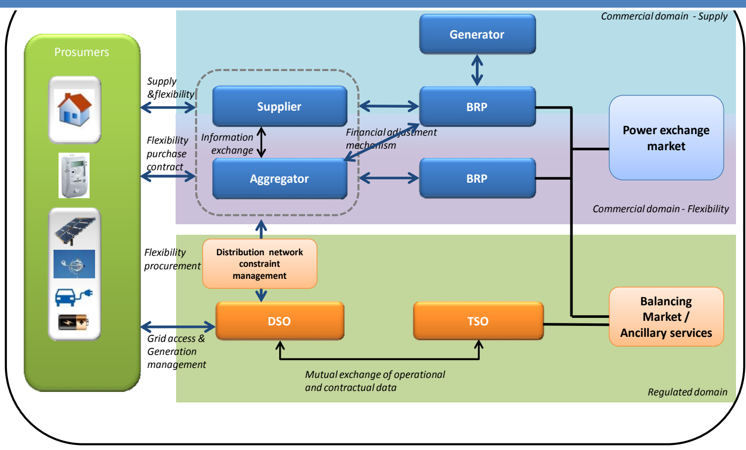
2015

Regulatory Recommendations for the Deployment of Flexibility



EG3 REPORT

SMART GRID TASK FORCE

January 2015

ACKNOWLEDGEMENTS

This report has been prepared by the Expert Group 3 (EG3, 'Regulatory Recommendations for Smart Grids Deployment') of the Smart Grids Task Force and is a product of intensive work and discussions amongst EG3 stakeholders during 2014. Special thanks are due to all the experts (listed in Annex 1) who contributed in the course of this work and especially to the Editorial Team (listed in Annex 2)

DISCLAIMER

This document reviews the value which demand side flexibility could be able to bring to the energy system and its possible impact to the future market development in Europe. The sole source of this flexibility, are consumers, in the form of industrial, commercial and domestic providers. They may be using their own consumption flexibility or different forms of distributed generation and storage. They will provide their flexibility services to a range of 'procurers', including TSOs, DSOs, suppliers, directly or via aggregators. They may also benefit from their flexibility directly by, for example, reacting to price signals (which are) reflecting variations in the spot market price. The regulatory and commercial arrangements should ensure that there are no undue barriers for consumers' possibility to act in the markets, and that their interests are promoted and protected.

Nevertheless, this document does not claim to provide the single possible solution for current and future challenges of the energy system. Flexibility provided by consumers can be one way to address challenges e.g. avoiding network congestions.

In respect of its focus, this document does not cover other options -such as generation management, network reinforcement and intelligent network operation- since the needs of energy systems are very heterogeneous throughout the European Member States. This diversity arises for instance from the level of connected renewable energy sources, population density, level of industrialization, geographic structure and market design. Member states should therefore be able to select the most efficient options to ensure security of supply according to their energy system and after the realization of a cost benefit analysis.

This document is the result of the consensus reached among experts of the Expert Group for Regulatory Recommendations for Smart Grids deployment (EG3) within the Smart Grids Task Force.

SMART GRID TASK FORCE

EG3 REPORT

Regulatory Recommendations for the Deployment of Flexibility

January 2015

Expert Group 3 - Regulatory Recommendations for Smart Grids Deployment

Contents

Executive Summary

The European Commission’s 2030 policy framework seeks to decarbonise the energy system. This framework encourages the electrification of heat and transport, as well as the connection of more intermittent generation. As these policies take effect, the electricity system will become more complex to plan, control and balance. More flexibility will be needed to ensure that the energy system is able to cope with the future challenges. It will be key to delivering an affordable and climate-friendly energy system.

The present report is composed of four chapters: 'Flexibility', 'Regulatory and Commercial arrangements', 'Incentives' and 'Recommendations'. The report focuses on flexibility from distributed resources, including demand side participation, and seeks to identify flexibility services, relevant value chains, but also the necessary commercial and market arrangements, while it answers the question on how different actors can be incentivised to provide and use flexibility. Finally, concrete recommendations are provided to the European Commission, to policy makers and stakeholders, for removing regulatory barriers and incentivising the uptake of flexibility from distributed resources.

Chapter 1 defines flexibility on an individual basis as a service provided by a network user to the energy system by changing its generation and/or consumption patterns in response to an external signal. Domestic and commercial consumers and distributed generators can provide flexibility services to help manage the emerging complexity. Flexibility services offer potential value to parties across the energy system. They could enable suppliers to optimise their portfolios; network operators to delay or avoid network reinforcement; and system operators to balance the system and manage constraints at an efficient cost.

Providers of flexibility, on the other hand, can benefit from providing a service through direct payments or savings on energy purchases. Achieving the full potential benefit of flexibility will require market arrangements that reward the provider of a flexibility service for the benefits it brings to the system.

Customers need to be properly engaged and incentivised to provide flexibility. Key enablers are needed to encourage and empower them to participate effectively in the flexibility market. Regulation and market rules will be needed to protect consumers’ interests; to ensure that they stay in control of their involvement in the flexibility market and to ensure that they understand the benefits (and obligations) of participating in it.

Smart technologies and appliances (under appropriate standards) will enable flexibility users and procurers (e.g. TSOs, DSOs, suppliers or aggregators) to develop grid and retail products and services tailored to the needs of the flexibility service providers. These products and services will need to be clear and simple so that customers can easily evaluate and compare them. This will support choice and promote competition in the market by helping customers to find the product and services that suits them best.

Chapter 2 identifies the actions which are required in order to enable European consumers to offer their flexibility in the energy markets and benefit from it. The chapter deals with barriers in realising the benefits of flexibility and new commercial and regulatory arrangements to overcome them. Currently, the ability of consumers to offer their flexibility in the capacity, forward, day ahead, intraday and balancing markets, is limited. The result is that not all of the demand side flexibility which could be provided by motivated and willing consumers is accessed. The chapter addresses the regulatory and the commercial arrangements required to enable industrial, commercial and residential consumers, to offer their flexibility in the organised electricity markets, and thus, unlock the benefits of their demand side flexibility.

A first step in order to enable demand side flexibility to participate in energy markets is to accept flexibility resources in the full range of energy markets and treat them on an equal basis with existing resources. This requires as a basis the proper transposition and implementation from Member States of the Third Energy Package, the Energy Efficiency Directive as well as the upcoming European Network Codes, which have the potential to pave the way for demand response and set rules that allow all flexibility service providers (e.g. suppliers or third party aggregators) to compete on a level playing field.

The consumer should have access to the best demand side flexibility offers available and to the service providers of their choice. Aggregated load should be legal, facilitated and enabled in all markets. Aggregators and suppliers should have the same ability to extract the value of flexibility services on behalf of their customers.

In order to engage consumers, an offer must be reliable, affordable, simple, while at the same time consumers' protection and empowerment should be ensured. The benefits for consumers must be clear and measurable, and it will be important to provide comprehensive general information as well as tools for comparing flexibility offers. This implies a need for data access and dynamic pricing for consumers, particularly for domestic ones, and requirements for consumers' participation within the energy markets.

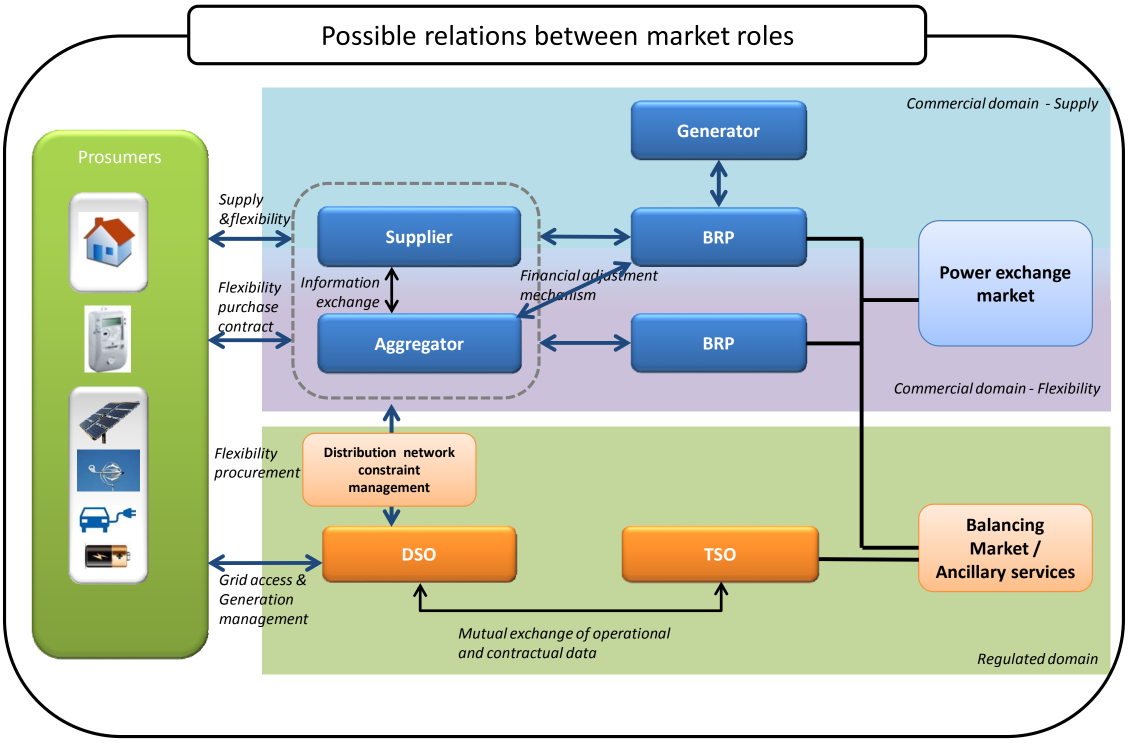
It is also necessary to ensure consumer inclusivity. All consumers should have the chance to participate and there should be protections in place for those that are unable to. The impact of demand side flexibility options on all domestic customers and especially vulnerable consumers need to be considered, so that the benefits are shared appropriately and no one is adversely affected.

Well-defined and appropriate measurement and verification protocols for flexibility are needed to realise cost effective market coordination. Smart metering systems are necessary for the measuring and settlement process, if aggregated flexibilities want to participate in balancing markets. One essential part of enabling demand side resources to participate in the markets, in the case of volume-based flexibility, includes the use of a baseline methodology in order to measure the flexibility provided by the consumers.

If contractual arrangements are necessary between market parties (BRP, Supplier, DSO, TSO, aggregator), they should be streamlined and simple, and reflect the respective benefits, costs and risks for all parties. Contractual arrangements should also allow consumers to access any service provider of their choosing without previous permission of other market parties. Standard contracts should ensure smooth contractual process, fair financial adjustment mechanism and standard communications procedures between aggregation service provider and the BRP/supplier. When relevant, contracts, communication and money flows can be directed through an independent third party.

A financial adjustment mechanism should be in place when consumers are contracting with an independent aggregator, in order to ensure that all the electricity sourced on the market and consumed by end-customers is paid to the actor who sourced it. This mechanism should protect the BRP from having unfair costs incurred through the fulfilment of its balancing requirements.

Chapter 2 also examines the possible relations between market roles, and roles and responsibilities of different actors. The following figure presents the possible relations:



DSOs should have the opportunity to use flexibility services where this provides a benefit to the network and hence to consumers. Through proper regulation DSO customers can benefit from new services which can enhance competitive markets. DSOs may need visibility of the planned aggregation actions connected to their networks in order to mitigate potential conflicts with network operation, either through commercial flexibility services or through internal network control actions, depending on the state of the system. DSOs should be able to define the different system states and market parties should have access to transparent information about the state of the system (e.g. 'traffic light' concept). Furthermore, non-discriminatory access to data is essential for a functioning energy market and operation of the distribution network. The data manager – the DSO in many Members States - should equally provide to all market parties, new and existing, sufficient, differentiated and timely data via appropriate market facilitation services.

TSOs should act as neutral market facilitators between aggregators, BRPs and suppliers, providing the communication and settlement services. For instance, as the balancing markets are usually the first point of entry for investment in large scale demand side flexibility, ensuring fair competition within these markets, will to some extent decide the overall level of investment in flexibility services within a given Member State. As these markets develop it will be increasingly important that TSOs and DSOs communicate and coordinate their actions and exchange relevant operational data with each other.

The European Commission and the National Regulatory Authorities have a critical part to play in the successful development of demand side flexibility. They will ensure that essential consumer protection requirements, technical, contractual and data handling requirements, are fulfilled by the flexibility service providers for a well-functioning market. They should also play an integral role in clarifying the roles and responsibilities of the different market participants. They should work with DSOs and TSOs to ensure they are given the necessary tools to improve the efficiency of their networks. They should also work together to develop a number of relevant financial adjustment mechanisms facilitating further integration of the different EU energy markets and allow demand side flexibility to participate on a level playing field. Market rules should be holistic and developed in close cooperation with all relevant stakeholders, including aggregators, BRPs, consumers, suppliers and network operators.

Chapter 3 discusses the role of incentives in achieving functioning markets with flexibility, since such an option will only develop if there is an added value for the customers, and all the market participants see a business case in developing the products and services while the markets sustain themselves without subsidies. Only when there are externalities or other market failures that justify their use as a tool to maximize societal benefits, the use of incentives could be considered either to:

- kick-start a new market
- introduce changes to the existing markets
- ensure efficient investment decisions are made and
- innovative solutions are implemented in the long term or to contribute to consumer behaviour change programmes.

The report focus on incentives that are either explicitly created by government policies or regulation (different authorities/institutions can be responsible for incentives in countries) to achieve efficient market functioning and tapping the potential value of flexibility for the customer.

Chapter 3 also examines which business fields and actors may need incentives in the context of flexibility. These may include: Consumers via improved price signals; Network companies in the energy industry to make efficient investments; Non-regulated companies and competitive actors in the energy industry to operate in the market in an efficient way (telecommunication operators, ICT or manufacturers to promote interoperability of products and protocols).

In addition, synergies between smart grid and broadband deployment, while ensuring a secure and stable energy grid operation (electricity and gas) and respecting each party’s roles and responsibilities, could facilitate efficient deployment of the smart grid infrastructure and hence flexibility options. Additional innovative ways for utilities to efficiently deploy smart grids by making use of ICT solutions should be considered, and also pilots exploring innovative technological, operating and commercial arrangement at infrastructure level between telecommunication operators and utilities should be supported where deemed beneficial.

Last but not least, incentives for development and roll-out of home appliances could be also considered, if this proves necessary. Smart appliances could potentially receive incentives in the early stages of their development to reduce the initial acquisition cost for the end users in order to speed up the uptake of smart appliances and enable residential consumer participation in the electricity market.

The report concludes with Chapter 4 where fourteen recommendations are addressed to the European Commission, to Member States, to NRAs or stakeholders such as TSOs and DSOs. The aim should be to ensure the equal access of demand side to electricity markets, and equal treatment of all relevant actors. The existing market model should allow the integration of new actors under necessary commercial arrangements and adjustment of rules. Network operators should be incentivised to enable and use flexibility in order to optimise grid operation and investments, while further collaboration between TSOs and DSOs for secure operation, is necessary. Transparent and non-discriminatory provision of data from data managers to relevant service providers should be guaranteed, in order to support the development of new products and competition in the market. Finally, a clear framework and necessary protections for domestic customers should be in place, while end-user prices and consumers' policies should incentivise consumers' participation and rewards in providing flexibility.

Brussels, January 2015

Chapter 1. Flexibility

The energy market is undergoing a dramatic change. New technologies and political determination are opening up new opportunities and perspectives, and many consumers will assume a completely new role as active participants in the market. Consumers will be central to this new market and their benefits must be maximised. Understanding consumers' behaviour and how best to incentivise their engagement in the market is essential, as consumer empowerment will be key to unlocking market potential.

This Chapter will focus on describing the requirements for flexibility, the future state definitions of flexibility, and on identifying issues relevant to the use of potential flexibility. It addresses two key questions:

- How flexibility from distributed resources, including demand side, can support the overall efficiency and security of the system, and;
- How to achieve active system user participation within a Smart Grid context.

The scope of the report encompasses electricity and gas. Flexibility is not a new concept; today it is applied in forward, intraday and balancing markets, as well as in constraints management for the TSO[1]. This report will focus on demand side flexibility and distributed generation flexibility which can provide flexibility resources in all market arrangements, and in possible future flexibility markets at distribution grid level. It will examine how the engagement and empowerment of the consumer (and other providers of flexibility) can be enabled and encouraged within regulatory frameworks and market structures.

This chapter starts by defining flexibility and the services that flexibility can provide to the system. It assesses the benefits for different stakeholders and analyses in some detail the requirements for the different services. It addresses consumer engagement and identifies the enablers and the questions that need to be answered to facilitate flexibility. This report builds on existing work. A reference of all the studies used can be found in at the reference list at the end of this report.

1. Definition of Flexibility

Expert Group 3 concluded that it is necessary to define flexibility in order to provide a common understanding among stakeholders. The Group agreed to use the definition of flexibility, as stated below[2]:

"On an individual level, flexibility is the modification of generation injection and/or consumption patterns in reaction to an external signal (price signal or activation) in order to provide a service within the energy system. The parameters used to characterize

[1] COM (2013) 7243 "Delivering the internal electricity market and making most out of public intervention"
[2] Based on the definition in the Eurelectric report on Flexibility and Aggregation, January. 2014

flexibility in electricity include: the amount of power modulation, the duration, the rate of change, the response time, the location etc." [Eurelectric, Jan 2014]. In gas potential parameters can be the market area, pressure level, gas quality.

Flexibility can be provided by both supply and demand on a large scale, for example by CCGT plants, industrial and commercial consumers, aggregated smaller household load, distributed generation, and energy storage. The approach should be holistic, and look at how flexibility in the energy system as a whole can be harnessed to achieve the objectives of balancing supply/demand at the least cost, meeting the varied interests in the value chain and preserving customer's rights to choice in the energy market.

Flexibility is intrinsically linked to a number of key terms or concepts and encompasses, Demand Side Response, Demand Management, Flexible Generation and Energy Storage on the supply and demand side. These and other relevant terms are also defined, and can be found in Annex 3.

2. Rational. Why do we need flexibility?

The European Commission[3] is investigating cost-efficient ways to make the European economy more climate-friendly. The transition to a low carbon society could boost Europe's economy, thanks to increased investment and innovation in clean technologies, and also low carbon energy sources. The European Commission's 2030 policy framework for climate and energy aims at decarbonising the energy system, which implies an enhanced need for system flexibility in order to accommodate growth of electrification and the increasing variable renewable energy share, and to mitigate the potential problems of ageing infrastructure.

Added to this is the challenge of improving consumer services, choice and cost through market competition. It is critical that future market developments and technological rollouts facilitate consumer engagement and provide direct benefits to consumers.

Challenges

Much of the low carbon generation coming on stream, and set to expand over the next decade, is based on renewable sources, such as wind, solar PV and biomass/biogas. Variations in wind and solar PV generation result in an electricity system which is more complex to plan control and balance.

The pattern of generation is moving away from primarily dispatchable to variable generation and the share of distributed resources will increase significantly. The rising share of variable generation in the system results in lower predictability in the markets and networks, and implies an increased need for flexibility to cope with this volatility.

[3] For further information please see the European Communication 2013/7243/EU "Delivering the internal electricity market and making most out of public intervention" which outlines the barriers, potentials and benefits of Demand Side Flexibility and substantiates the reasons and the need for flexibility.

Flexibility will be needed for both variable generation and the remainder of the capacity, and both on the supply and the demand side.

A further challenge to the electricity networks is the expected growth of the markets for the electrification of mobility and heating (power to heat), which have the potential to significantly increase peak demand above the design limits of existing electricity distribution networks.

Flexibility can help to avoid inefficiency in the market and allay the concerns of some governments and regulators that the future mix of electricity generation capacity delivered by the market may not meet demand at optimal costs. Such concerns are likely to grow as the share of renewable energy system (RES) generation increases, creating additional interest in the flexibility ensuring sufficient firm capacity as well as in tools needed to manage fluctuation in generation and demand.

To summarize: While it should be noted that flexibility will not replace traditional investment, increased integration of distributed energy resources (DER) and the growing peak demand for electricity will drive the need for increased flexibility, customer engagement and empowerment in order to maintain an affordable energy system (see Figure 1).

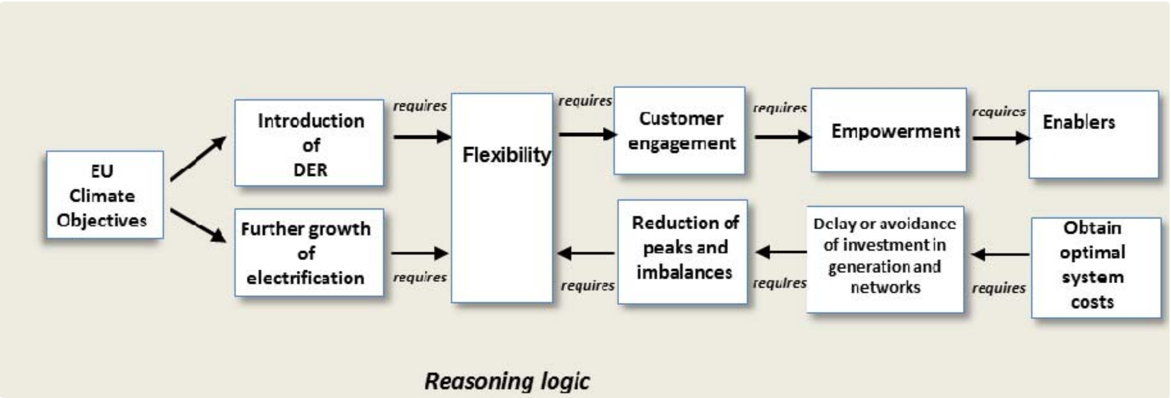


Figure 1. Reasoning logic

3. Consumer Empowerment

Creating flexibility on the demand side will be the key to success of the transition to a new energy paradigm, as shown in the previous section. This will require active participation and empowerment of customers in the Energy System.

This section defines what needs to be in place to facilitate consumer's (and other providers of flexibility's) engagement and empowerment to create demand side flexibility and allow a shift towards demand response.

What will consumer empowerment look like?

- Consumer interests will be properly protected in the transition to more flexibility.
- Consumers will be in control of optimising their consumption and their energy bill and will be empowered to contribute to other objectives, for instance environmental objectives.
- Consumers will understand their options in the (new) market so that they can engage with the new opportunities offered to them and will be made aware of the advantages of participating. This means that government, regulators, consumer bodies and both established and emerging market players take proactive steps to assist consumers (and other providers of flexibility) in becoming aware of what demand response means for them and the benefits (and obligations) as market participant of their participation.
- Consumers will receive the right incentives to participate in the flexibility market.
- Consumers will be empowered with the necessary tools including services tailored to consumer needs, and information and knowledge to actively participate in demand response.
- Consumers will be the owners of their own data, and its privacy and security protected.
- Consumers will be offered choice. Suppliers (who could also act as aggregators) and third party aggregators will provide offers in a level playing field[4].
- Consumers will be offered simple products that contain added value and products that are easy to understand and compare. Simplicity and transparency will be a key success factor for engaging with domestic consumers. A balance will need to be found between providing the consumer with more information and the need for simplicity to avoid confusion.
- Offers from suppliers and third party aggregators will be able to be easily evaluated to understand which investments are the smartest from the perspective of the prosumer.
- Billing information will be presented in a way to make customers aware of the components as well as the total cost of supply (supply, network costs, tax, etc.).
- Clear market rules and processes will be in place, which show what they mean for the consumer as a market participant.

An appropriate balance needs to be struck between the interests of flexibility users and flexibility providers as well as between giving customers' choice and affording them the necessary protection. Ultimately in a competitive flexibility market, suppliers and aggregators will package and test their customer propositions and the most effective propositions will succeed if competing on a level playing field. Thus competitive pressures will ensure development of the most effective consumer engagement techniques. Key to understanding consumer engagement is the need to understand

[4] In this report the terms “supplier” and “aggregator” are used as legal entities, having responsibilities to execute certain roles and delivering products. For a better understanding on how aggregators and suppliers relate, in terms of roles and products, see annex 8

consumer behaviour and an assessment of the different consumer types should be undertaken.

4. Flexibility services (products and markets)

This section describes the users of flexibility services and the system users that can provide these services. It will also identify what services are required by flexibility users and what services can be offered by flexibility providers. It outlines how the requirements for flexibility services could be met by the providers of flexibility services.

The growing share of variable non-dispatchable generation in Europe (replacing traditional generation) is decreasing the flexibility in the electricity system. Flexibility on the demand side could be used by suppliers to optimise their portfolio, network operators to delay or avoid network reinforcement, and by system operators for balancing and constraints management purposes.

Gas systems are more flexible than electricity systems, but also require balancing. Gas can be stored easily in large quantities in the system. The gas system also has a unique feature in that it is also complementary to the electricity energy system: if too much electricity is generated (for instance wind or solar), the surplus of electricity could be transformed into natural gas (and hydrogen).

In principle everyone connected to the grid is responsible for their individual balance. Households and small medium enterprises (SMEs) typically outsource their balancing responsibility to a supplier who in turn can outsource its balancing responsibility to a Balance Responsible Party (BRP). TSOs are responsible for keeping their respective balancing zones, also known as control areas, in balance at all times.

To ensure this responsibility:

- In principle, BRPs are responsible for balancing their own portfolio. BRPs who maintain their balance are rewarded, and BRPs who do not are penalised. TSOs are financially neutral in this balancing arrangement.
- TSOs buy upwards or downwards adjustments (i.e. activate supply or demand) to restore balance.

4.1 Users/buyers and requirements of flexibility services

This section is about the services required by the different actors in the value chain, with the services that can be provided by domestic, industrial and commercial customers, and distributed generators. It specifies the requirements for flexibility services per category of user and makes distinction between electricity (E) and gas (G) networks when considered needed.

1. **Balance Responsible Parties:** BRP requires flexibility for the following:

Balance Responsible Parties are key users of flexibility. Currently the majority of flexibility in the electrical system is provided by transmission connected power plants (especially conventional power plants like natural gas-fired plants and pumped hydro-storage plants). Energy trades are usually the result of long term bilateral transactions, while flexibility is typically required for the short term planning of supply and demand. This planning is called portfolio optimization.

When energy is bought or sold in the market, firmness is very important in relation to amount and timescales. Relatively large amounts of energy bought must have high firmness as the number of options to choose from will diminish with time. The balancing requirements placed on a BRP are determined by grid codes.

Portfolio optimisation, adjusting production/adjusting demand:
A BRP has different options for using flexibility at different points in time. It is more difficult to decrease or increase outputs for certain types of generation units such as wind or solar as for conventional types of generation. Flexibility from other generation/supply units or demand is often than necessary for BRP portfolio optimisation[5]. Trading energy is also an option to optimize the portfolio for a BRP.

(E) Generation capacity adequacy: One element of generation adequacy is the need to ensure that new flexible resources are delivered to complement variable wind and solar power generation in particular. The other element is the need to ensure that sufficient capacity is available to meet demand on the system at times of highest system stress.

BRP Flexibility requirements: peak shifting, demand and generation adjustments.

2. **Transmission system operator:** TSOs require flexibility for the following:

(E) Frequency control: TSOs are responsible for maintaining system balance and hence for adjusting the system user actions[6]. In order to achieve this, TSOs use a portfolio of reserves which can be activated when encountering disturbances or imbalances. The activation of these reserves (frequency containment reserves (FCR), frequency restoration reserves (FRR) and replacement reserves (RR) would result in generation facilities, energy storage devices or demand side reducing or increasing their energy output or intake[7].

---

[5] In principle the actions of a BRP in the electrical market are the same as a BRP in a gas market. A substantial amount of power is produced by flexible gas fired power plants, and as a result the flexibility of the gas system contributes to the flexibility of the electrical system.

[6] (E&G) there are usually strict rules and requirements for participation in the system balancing market. Many of the requirements are related to the firmness of the bids which must be high and the solvency of the companies

[7] See Annex 3, table 3 Activation of primary, secondary and tertiary control reserves

(E) Reactive power control: TSOs require reactive power provision from the generation facilities connected to their network. Reactive power provision is remunerated as a service in some but not all EU Member States.

(G) System balancing: The gas transmission system operator must ensure that quantities of gas injected into the system match withdrawals from the system[8].

(E) Congestion management: Transmission congestion occurs when there is not enough transmission capability to support all requests for transmission services. In order to ensure reliability, transmission system operators must re-dispatch generation and apply market based congestion management between zones. The cost of transmission congestion is equivalent to the net cost of the replacement power that must be supplied or the cost of demand reduction that compensates for deliveries that cannot be executed.

(G) Gas congestion management: Gas congestion management can work in two directions, for example, decreasing the transport flow when a gas fired power plant does not consume as much as planned, or increasing the transport flows when a large power plant compensates for a decrease in the generation of wind and/or solar. In these circumstances, TSOs will purchase local products (injection or storage). Emergency rules will apply where this is unsuccessful.

(E) Grid losses: DG could reduce the amount of energy lost in transporting electricity because the electricity is generated nearer to where it is used.

TSO flexibility requirements: generation and demand adjustments, generation curtailment and provision of reactive power, peak shifting.

3. **Distribution system operator:** DSOs require flexibility for the following:

(E) Long term congestion management: Currently, DSOs provide grid capacity (guaranteed access) that may not be fully used[9] due to for example, consumer behaviour or local consumption of electricity produced by Distributed Generation (DG). With the rise in DER, the system cannot be designed to cater for all contingencies without significant investment in basic network infrastructure. Different levels of grid access and real-time flexibility can reduce or postpone investment needs.

(E&G) Short term security congestion management: DSOs should have the ability to obtain flexibility from DG, energy storage and demand in order to optimise network availability or to manage network conditions in the most economic manner. Network reinforcement could be deferred until it becomes more cost-effective than the on-going cost of procuring flexibility services. DG owners should be informed in advance about expectations of curtailment. Congestion management for gas distribution systems works the same way as for transmission systems.

---

[8] As a result of the intrinsic system storage capacity (line pack), the gas system itself provides a lot of flexibility.

[9] Even when fully used, the duration of the use is very short, in the range of a few hours per year.

(E) Voltage control / reactive power management: Injection of active power leads to voltage profile modifications. Voltage increase (overvoltage) is the most common issue with the connection of DG units. Reversed power flows (flows from distribution to transmission) occur when DG production exceeds local load. If the DG is properly coordinated with the available voltage and reactive power equipment, a proper voltage regulation can still be maintained in the presence of that DG. In some situations DG will have to be curtailed to prevent voltages from rising above statutory limits, either actively by the DSO, or automatically by interconnection protections.

(E) Grid losses: At local level, DG could reduce the amount of energy lost in distributing electricity because the electricity is generated closer to where it is used.

DSO Flexibility requirements: generation and demand adjustments, generation curtailment and provision of reactive power, peak shifting.

4.2 Providers and description of flexibility services

This section describes the flexibility services offered in more detail per category of provider of flexibility services.

Aggregation offers the opportunity to maximise the flexibility potential of grid users. Aggregation is a commercial function of pooling de-centralised generation and/or consumption to provide services to actors within the system. Aggregators identify and aggregate customer flexibility which can be done via a range of flexibility products.

1. (Aggregated) industrial and commercial users:

Industrial and commercial users can operate as a group (through aggregation) or individually[10].

(E&G) When an industrial or commercial user offers flexibility (automated or manually) activated in response to a market signal, such flexibility will be remunerated by a BRP/supplier/aggregator or TSO/DSO. The means and type of remuneration depends on national market rules.

(E) A consumer/generator contracted by a third party aggregator for its flexibility would have a separate contract with its third party aggregator in addition to its contract with the supplier. How energy is allocated depends on the market model. The contract agreement will determine the remuneration of the provider of flexibility services. Suppliers or third party aggregators may then have a contract with the DSO or TSO for providing it with peak shifting or demand adjustment services. Curtailment of distributed generation can be both an individual and an aggregated response action.

[10] Examples of industrial users are: equipment which is controllable and fast acting, such as grinders, smelters, heating and cooling systems but also on-site generation or energy storage. Particularly suitable loads are thermal loads, such as air conditioning, water heaters, space heaters, boilers, freezers, refrigeration etc.

Products that can be provided: (E&G) Peak shifting, Demand adjustments (manually/automatically), Curtailment products, (E) FRR/RR,

2. Aggregated domestic consumers:

(E) The flexibility of domestic customers will likely be pooled by the supplier or aggregator. Remuneration will depend on the contract with the aggregator.

Flexibility can be provided using manual or automated actions (starting, increasing, decreasing or stopping of the generation or load). The market environment must support both automated and manual intervention. Time of use tariffs (critical, dynamic and static) can also be used to provide flexibility, and could be offered by either the DSO via network tariffs or by the supplier. This could involve the active response by consumers to a price signal which could encourage consumers to refrain from using energy during peak times (peak demand, peak network usage or congestion or faults on the network).

Products that can be provided: (E) Peak shifting, Demand adjustments, use of small scale generation (or back up generation).

3. (Aggregated) distributed generation (DG):

There are many different forms of distributed energy resources, for instance cogeneration or combined heat and power (CHP), wind turbines, solar panels, energy storage etc. along with biogas in the gas system.

(E) Aggregating DG depends on the controllability of the generation unit. Energy storage, CHP or back-up generators are more controllable than wind turbines or solar panels. The more generation can be controlled, the easier the aggregation of such units becomes, and if storage (where economically feasible) participates in the aggregation, aggregation will become even more controllable.

Products that can be provided: (E) Generation adjustments, (G) Biogas injections, (E) FRR/RR, (E&G) Curtailment products (congestion management services), (E) Reactive power, losses reduction

4.3 Connecting flexibility users and flexibility providers

This section connects the requirements of flexibility users with flexibility providers. The various ‘Enablers’ that will facilitate this are described in Section 6.

The table below is a summary of the Flexibility Services Matrix that can be found in Annex 4. It attempts to link these services with the role that each service can fulfil.

Table 1: linking flexibility users with flexibility providers

Service that can be provided	System user that can offer this service	Function that this product can fulfil	Flexibility user requiring this service
(E) Peak shifting (i.e. shifting the peak demand) (G) Peak shifting	Aggregated (or individual) industrial and commercial users Aggregated domestic customers	Long term congestion management. Portfolio optimization Generation capacity adequacy	DSO BRP TSO
(E&G) Demand adjustments – manually/automatically	Aggregated (or individual) industrial and commercial users Aggregated domestic customers	Short term congestion management Portfolio optimization Generation capacity adequacy	DSO BRP TSO
(E) FC/FRR/RR balancing services	Aggregated or individual industrial and commercial users Aggregated distributed generation	Frequency control	TSO
Generation adjustments	(Aggregated) distributed generation	Short term congestion management Grid losses reduction	DSO TSO
(G) Biogas injections	Distributed generation	Long term congestion management Portfolio optimization	DSO TSO BRP
Curtailment products	(Aggregated) distributed generation (Aggregated) industrial and commercial users Aggregated domestic customers	Short term congestion management	DSO TSO
Reactive power (mandatory)	(Aggregated) distributed generation	Voltage control	DSO TSO

5. Value of flexibility

This section outlines the value of flexibility to different parties including consumers, and refers to existing cost benefit analysis (CBAs). The value of flexibility for a party in the value chain represents avoided costs or gained benefits.

This section outlines the benefits to the various parties and the way these benefits are shared. Chapter 2 will look at the potential barriers that prevent value from being maximised in the value chain.

Achieving the full potential of flexibility will require a market design that rewards the provider of flexibility for the benefits it brings to the system. The incentives that consumers receive to adjust their consumption should reflect the value that their flexibility could bring to the system. Benefits from flexibility described are expected to be present in the spot & balancing markets, as well as in the forward market.

5.1 Benefits for providers of flexibility services (residential, business and distributed generators)

- Providers of flexibility services, (industrial, commercial, residential and DG) should be paid for their flexibility. If the flexibility service is provided through an aggregator or a supplier, these service providers will withhold a portion of the value as a payment for their services.
- Another option for consumers to receive benefits is through time of use tariffs offered either directly through the DSO, or passed through by the supplier. Time of use tariffs rely on a price signal to provide an incentive to respond and will allow consumers to see the value of their service. This however is subject to market competition.
- Providers of flexibility services (business, residential, and DG) should be rewarded for flexibility that contributes to reducing network constraints. The DSO/TSO would procure this flexibility from consumers, via suppliers and/or aggregators, who will be paid for it (the DSO/TSO may also need to compensate for any imbalance). The exact financial arrangement would have to be determined depending on the value of resolving the constraint and the number of consumers available to provide that service. A high number of consumers offering a service in a given area could lead to the creation of a competitive market.
- Part of the benefits realised by DSOs and TSOs could be returned to consumers via the relevant price control mechanism.

The provider of flexibility services can be rewarded by a financial compensation. The consumer can also optimise their bill, for example through the consumption of energy at less expensive times (load shifting), or through demand reduction. The financial benefits for customers can come from varied sources, i.e. a direct financial compensation or savings on purchased energy, or a combination of the above, etc.

5.2 Benefits for users of flexibility services

<u>Benefits for Market Parties (suppliers, aggregators and BRPs)</u>

- Flexibility can contribute to portfolio optimisation for BRPs.
- In the balancing market, there is also a value in flexibility as flexibility, offered by BRPs to TSOs, can contribute to balancing reserves and frequency control. The value of flexibility equals the cost of avoided imbalance and/or the profits which

can be gained in the balancing market. The extent to which these benefits are forwarded to the consumer will be subject to market competition.

- DG operators will have an opportunity to provide flexibility services and can contribute to avoiding or delaying reinforcement costs, portfolio optimization, avoiding imbalance or reducing network constraints. How this is reflected in the balancing mechanism is dependent on the market model applied. It should be noted that DG as wind and PV, although variable resources, could also contribute to delivering flexibility, under curtailable or non-firm contracts.
- Traditional plant operators, upon successful integration of distributed generation, demand response, and/or storage facilities in their long term portfolio planning & optimisation processes, would be able to reduce investments and maintenance costs.

Benefits for regulated parties (TSOs and DSOs)

From a DSO point of view, as evidenced in the Reservices project[11], using flexibility services – in particular from distributed generation – at distribution level, can bring a number of quantifiable benefits (such as avoidance/deferral of capacity investment costs, reduction of losses, management of faults), both for network operators and grid users[12]:

- Avoidance/ deferral distribution network investments costs

  With increasing peak loads in the future, DSOs may decide that the traditional grid reinforcement approach is too costly (impacting on consumer network charges), and may decide to avoid or defer investment with the use of flexibility.
  MetaPV D3.4[13] compares the costs of a grid investment approach and a flexibility (PV reactive and active power and storage) approach, based on preliminary project data. The cost of the communication and control equipment is critical in the comparison. If the equipment price drops or can be shared with other services, it was observed that the flexibility usage is the most economic approach to increase grid capacity up to 100%. The UK has also developed an economic modelling approach for network investment, the Transform model, which compares smart and traditional solutions through to 2050. If flexibility avoids investments, the value of flexibility equals the CAPEX and OPEX of the avoided reinforcement. If flexibility services enable the DSO to defer investments, the benefit of flexibility can be calculated as the avoided return on capital over the deferral duration.

---

[11] Reservices, Deliverable D6.2,"Report on the evaluation and conclusion of the DSO case studies", available online: http://www.reservices-project.eu/wp-content/uploads/REserviceS-D6.2-Final.pdf

[12] Similar potential benefits are highlighted in the "Etude des avantages que l'effacement procure à la Collectivité et de leur intégration dans un dispositif de prime" published by the French Energy Regulatory Authority (CRE) in June 2013 (http://www.cre.fr/documents/consultations-publiques/principes-structurant-le-projet-de-proposition-de-decret-relatif-a-la-valorisation-des-effacements-de-consommation-d-electricite-sur-les-marches-de-l-electricite-et-le-mecanisme-d-ajustement/consulter-l-annexe-2-etude-des-avantages-que-l-effacement-procure-a-la-collectivite

[13] MetaPV, Deliverable D3.4: "Economic Evaluation of Grid Support from Photovoltaics: Methodology and Analysis." available online: http://www.metapv.eu/sites/default/files/PR_PR104283_D3.4_EconomicEvaluation_F.pdf (Based on preliminary data and assumptions. An updated version will be published in the final report).

If grid constraints become visible in the long term planning process, DSOs and TSOs may procure flexibility from consumers, via suppliers and/or aggregators to avoid congestion. They can also restructure their charges to incentivise DSR, etc. Further study may be needed to mitigate any risk of speculation, which would lead to the need for flexibility being unduly created by the market.

- Reduced electricity technical losses

  Transmission and distribution of a kWh from generators to consumers involves networks losses (power dissipation in distribution lines and transformers). Flexibility services can help to reduce losses. Network losses have a value and the value of flexibility corresponds to the amount of electricity that has not been lost. However, in cases where flexibility is used to defer network reinforcements, network losses may increase as the existing infrastructure would be more heavily loaded.

- Reduced curtailment of distributed generation and reduced outage times

  By using flexibility services, DSOs could better control voltage profiles and currents in areas with a high number of intermittent sources of electricity. Flexibility can thus directly benefit grid users (e.g. solar panel owners) who would be able to feed-in more energy to the grid, as a result of an increased DG to accommodate capacity. The value of flexibility is determined by the avoided investments and maintenance costs in capacity and voltage control. The Reservices project has shown that in some areas, the cost of accommodating DER could be decreased significantly through flexibility[14].

- Outage / fault management

  DSOs could benefit from better fault management through the use of flexibility. Critical event tariffs could be used when there is a network fault and would enable DSOs to direct load away from areas of the network experiencing problems. Flexibility could be used for post fault management, particularly on heavily loaded HV circuits which are likely to trip at peak time.

[14] The Reservices project shows that in some areas, such as the south of Germany, the cost of accommodating DER would be decreased by 50%. An Italian case study also shows that the total installed capacity of DER can increase by 28% thanks to the use of flexibility to better control voltage. The Improgres[14] project reached similar conclusions by studying the impact of advanced generation control and demand side management on three networks (one in the Netherlands, one in Germany, one in Spain). It also showed a lesser need for peak generation and lower balancing costs for the TSO.

Table 2 summary of benefits and costs for stakeholders of flexibility

	Costs	Party	Benefits	Party
Direct Effects	Investments in Smart Grids	DSO/TSO	Avoided investments	DSO/TSO
	Smart Grid Operation And Maintenance	DSO/TSO	Avoided grid losses	DSO/TSO
	Cost on location for equipment	Customers and market parties	Avoided investments in central capacity	Producers Suppliers
			More efficient use Of central capacity	Producers Suppliers
			Additional energy savings	Customers
			Reduced imbalance	BRP
Indirect and external effects	Welfare losses due to shift in functional Energy demand	Customers	Extra effects, e.g. CO_2 reduction	Society
			Welfare gains due to new services	Customers

6. Key Enablers

At present, some of the services described in section 5 cannot be offered by providers without the presence of enablers. A wide range of enablers can be implemented to encourage/facilitate participation in the market for flexibility services:

- Regulation & codes
- Market rules and processes
- Grid and retail products & tariffs
- ICT technology and standards
- Smart appliances and smart meters

The consumer cannot be forced to provide demand response. The consumer will weigh the financial benefits against the various other aspects (e.g. risk involved, loss of comfort, costs for additional devices or equipment). Clear market rules regarding allocation, metering, billing, reconciliation and data communication will be necessary. Clarity and simplicity is critical as for some of the services, different market participants can be involved with the same consumer.

Enablers in the form of new grid tariffs and products such as time of use tariffs, demand side response contracts, load limiting products and tariffs, demand reduction contracts, curtailment contracts or direct participation in the wholesale and retail markets may be developed. A financial reward (both grid tariffs and prices for supply) can take the form of:

- A restructured distribution use of system charge (grid tariff) based either on unit charge or a differential capacity charge for peak times of the day to reflect the cost of peak network usage, from either the supplier or DSO.
- A fixed price time-of-use tariff from the supplier and/or DSO (to encourage peak shifting) largely based on usage.
- A dynamic price time-of-use tariff from the supplier and/or DSO largely based on usage (this could be used to match supply with demand, e.g. in times of high wind generation or high demand).
- A critical price time- of-use tariff from the DSO which would be used for post fault management.
- A lower distribution use of system tariff (grid tariff) in exchange for fitting a load limiter on certain appliances (offered by either the DSO or supplier)
- Reduced connection charges in exchange for agreement with generators on non-firm contracts.

For most new price and tariff structures, more detailed measurements are needed (smart meters). The Energy Efficiency Directive should be correctly implemented and rules defined regarding the ability of DSOs to procure flexibility services from network users. For certain services to be offered, technology providers may be required, such as ICTs and equipment providers, and processes or rules may need to be amended or developed.

Smart appliances are a valuable enabler that allows and empowers consumers (in particular domestic consumers) to provide flexibility services in a smart grid. The consumer should have ultimate control over their appliance. Household appliances account for more than 40% of residential energy consumption and, in most cases, can be flexible in their time of use and automated. New generations of smart appliances can react to a utility signal notifying the real time price or cost or level of green energy available. This allows system users to optimise energy consumption while preserving their choice in the way they use energy. Care should be taken to ensure smart appliances are used in a way that does not lead to causing a second peak as all appliances react in the same way to a given signal, causing possible congestion. Smart metering systems[15] with an interface in the home that can provide consumers with near real-time information on energy consumption and costs, as well as supporting energy management services and home automation, are key enablers for demand flexibility.

7. Maximising the value of Flexibility Services

This section identifies the issues which may need to be addressed to ensure that the maximum potential of flexibility is realised.

Principles

[15] In many countries, the DSO is responsible for data provision in a fair and equitable manner.

1. Market participation

- Does the Market encourage and allow participation in demand side response or are there barriers to participation?
- Do consumers have direct access to markets?
- Are third party service providers enabled?
- How to enable multiple market parties active on one connection?

<u>Processes</u>

2. Operation

- How is flexibility acquired operationally? (Processes before and after" gate closure") Via bilateral contracts or via auction platforms?
- How are billing, settlement and validation carried out?

3. Coordination and balancing responsibility

- How should the process be coordinated to avoid problems in system operation in cases where multiple stakeholders acquire and provide flexibility?
- How to avoid regulatory loopholes and free-riding with respect to balancing responsibility, if customers sign contracts with multiple parties (for energy and flexibility?)

<u>Pricing</u>

4. Structure of price signals

- Should price signals be structured for simplicity or effectiveness and what offers are most appropriate for each customer type?
- Should these tariffs be combined or separate (e.g. retail or distribution) and what incentives are there to ensure that distribution price signals are passed through?

<u>Technology & standards</u>

5. Response type and data flow

- What type of response is required, manual or automated?
- What data is required and how does it flow between parties?
- Are measurement and verification protocols established, are they appropriate for consumers?

6. Equipment and standardisation

- What equipment, standards and technology are needed?
- Is energy storage seen as an acceptable resource at the TSO/DSO level?

Chapter 2 will address the above questions, which are identified as potential barriers in more detail.

Chapter 2. Regulatory and Commercial Arrangements required to enable demand side flexibility

Chapter 1 of this report reviewed the benefits which demand side flexibility can bring to the energy system and its importance to the future market development in Europe. The sole source of this flexibility, are consumers, in the form of industrial, commercial and domestic providers. They may be using their own consumption flexibility or different forms of distributed generation and storage. They will provide their flexibility services to a range of ‘buyers’, including TSOs, DSOs, suppliers, directly or via aggregators (see table 1, chapter 1). They may also benefit from their flexibility directly by, for example, reacting to variations in the spot market price. The regulatory and commercial arrangements should ensure that there are no undue barriers for consumers’ possibility to act in the markets, and that their interests are promoted and protected.

This chapter will examine actions required to enable European consumers to participate in the markets and benefit from their flexibility resources. It covers the following questions:

- What is the consumers right to sell flexibility?
- How can this be realized?
- Which flexibility market rules are required?
- Which are the regulatory structures needed in order to achieve those market rules?

Section 1 explains the consumer's right to sell flexibility and the benefits of demand reduction, section 2 reviews how consumer flexibility can be realised, and section 3 describes the roles and responsibilities in a future flexibility market.

1. The consumers right to sell flexibility

The guiding principle for creating a level playing field where the customer can be an important actor is equality - equal pay for equal work. The value of a MW should be decided regardless of who or what is providing that MW. When an equivalent service is provided, demand response flexibility resources, including customers’ self-generation, should receive the comparable payment as (traditional) generation.

To adjust consumption or injected electricity at strategic times, the customers (domestic, commercial[16] and industrial) need to be provided with information or control signals and/or financial incentives. Through this, demand side flexibility offer consumers, with and without self-generation, the opportunity to benefit directly from the smart grid and market competition. In case control signals are chosen in place of information, consumers will be adequately protected, notably by ensuring them the possibility to opt-out without restriction.

[16] The term Commercial is taken to mean all buildings and businesses which are not directly industrial or residential; in other words, municipal buildings, SMEs, businesses such as hotels, office spaces, etc.

1.1 The benefits of demand reduction

A customer may choose, either on its own or through the support of an aggregation service provider, to lower consumption during times of high wholesale prices. The customer may do this to lower its electricity costs and not as any form of service to the system, market participants, DSOs or TSOs. If this takes place, the customer is not selling flexibility as a service but (saved) energy as a commodity in the wholesale market. Access to intra-day pricing is therefore a powerful tool for allowing consumers to benefit directly from their own flexibility, serving their own interests.

Currently, the ability of consumers to offer their demand side flexibility to be used in the capacity, forward, day ahead, intraday and balancing markets, is limited. Industrial consumers and generators with their own bi-lateral power purchasing agreements can participate. Smaller industrial, commercial or domestic consumer access to flexibility services varies in Member States but tend to be limited. The result is that not all of the demand side flexibility which could be provided by motivated and willing consumers is accessed.

In order to participate in energy or system services markets, consumers shall be given the possibility to exploit the benefits of modifying their flexible consumption and injection.

2. How consumer flexibility can be realised

Commercial and industrial consumers are often the first to participate in flexibility markets. Their business cases are positive (even when not providing the full range of flexibility services in the vast majority of Europe) since one a significant amount of load can be accessed through one connection point. The business case for domestic consumers can be more difficult, depending on the availability of flexibility offers, the amount of electricity consumed and produced per household and, crucially, their willingness to engage.

2.1 Acceptance of demand side resources in the markets

Step one to enable demand side flexibility to participate in energy markets is to accept flexibility as a resource in the full range of markets – including capacity, forward, day ahead, intraday and all balancing markets. This requires as a basis the proper national transposition of the Third Energy Package, the Energy Efficiency Directive as well as the Network Codes, which have the potential to pave the way for demand response and set rules that allow all flexibility providers to compete on a level playing field. Furthermore, any framework regulating demand response for TSOs should take care not to hinder the development of flexibility services for DSOs and, likewise, any framework for DSOs should take care not to hinder agreements in contracts between suppliers and balance service providers (BSPs) under normal circumstances.

2.2 Recognition of aggregation service providers

All aggregation service providers must be able to compete on a level playing field: aggregated load should be legal, facilitated and enabled in all markets. Aggregators and suppliers should have the same ability to extract the value of flexibility services on behalf of their consumers. Demand side flexibility needs to be treated on an equal footing with generation on the basis of the volumes effectively delivered (whether in the form of electricity generated at customer site or demand variations) and accepted on all markets.

A consumer can benefit from demand side flexibility wherever he/she can get access to market data and adapt energy consumption (behaviour) or injection accordingly. Where this is not feasible a middleman such as an aggregation service provider can add value i.e. by allowing the consumer to sell its flexibility as a quantified resource into the markets. To attract the consumer, the reward for saving or selling energy need to be clear and to be an incentive for participation.

The main function of aggregation is to identify and gather the flexibilities of consumers to build flexible capacity. Aggregators create agreements with industrial, commercial and domestic consumers to aggregate those end-users' capability to adjust energy and/or shift loads and provide injection on short notice. They may, depending on the type of aggregator, create one pool of aggregated load made up of many smaller consumer loads and sell this as a single resource (see below). These loads can include electric heating and cooling, fans, water boilers, grinders, smelters, water pumps, freezers, PV, EV etc.

In most European countries consumers are not enabled to offer their flexibility[17]. It is the suppliers who buy the energy and BRPs being responsible for their imbalances. At the same time – if a consumer participates in demand response - the BRP or supplier can be put out of balance, or incur losses from energy purchases made during balancing.

2.3 Consumer participation requirements and offerings

In order to engage consumers, an offer must be reliable, affordable, simple, and at the same time protect and empower[18]. The benefits must be clear and measurable, and it will be important to provide comprehensive general information as well as tools for comparing flexibility offers.[19] This implies a need for data access and dynamic pricing for domestic consumers and requirements for consumer participation within the balancing and ancillary services markets.

The engagement of a consumer to participate in demand response depends on individual preferences regarding the costs and benefits that the consumer associates with participation. Consumers make an individual evaluation of these criteria, as the level of flexibility varies from one consumer to another. [20]

---

[17] SEDC-Mapping_DR_In_Europe-2014 0411.

[18] The CEER/BEUC 2020 Vision for the European Energy Customers.

[19] General information tools such as energy feedback campaigns can increase customer awareness and are a critical enabler in the development of energy efficiency and demand response offerings. A tool for comparability is suggested by the THINK report "Shift not Drift", namely the establishment of minimum contract terms. These terms could according to THINK include price, volume, intervals, termination fees, notice times, data access right, appliance control rights, etc. (These terms clearly also regard transparency, not only comparability.).

[20] The concepts of loss of autonomy should be clearly distinguished from flexibility. In the first case utilities control directly energy consumption and only secondarily need to rely on price signals; in the latter price signals are the main tool to achieve demand response. The share of value for consumers and for regulated participants is very different in the two cases.

Consumers within the retail markets (domestic and commercial consumers)

Empowerment from a domestic and commercial consumer's perspective will include addressing the precepts for consumer control, e.g. the usability of heating controls, education, standards of service, affordable options, interoperability, ease of switching etc. To be fully empowered to manage their energy resources, all consumers, but particularly domestic and commercial, require two basic enablers:

- **Data** on consumption, self-production and pricing, with sufficient detail consistent with the flexibility market, and with respect of privacy requirements.
- **Pricing options,** meaning a price structure that allows savings from shifting demand.

Consumers need accurate billing information based on actual volume and timing of consumption, allowing the understanding of their consumption patterns and possibilities for change, and they should have the right to be billed according to their actual consumption.
The market structure and the framework legislation have to reflect this need allowing a transparent and smooth flow of data between market and regulated participants, and at the same time clearly ensure the fundamental right for the consumers to be in control of their data and always explicitly give their consent before data is made available to parties not already contracted by the customer. The customer should also have the right to withdraw from such consent.

There may be gains to be made from dynamic pricing for domestic and commercial consumers (mostly for larger energy consumers) though consumer confusion and miscommunication must be avoided. The communication of price signals is one factor to increase consumers' interest. Price signals should be structured both for effectiveness and simplicity. It is likely that price signals will become more complex as time goes on, and especially if they involve a dynamic element, instead of being simple, which may be impossible, they should be understandable by the consumer.
When demand response is bundled with other service offers, consumers may benefit from disaggregated billing information to understand their consumption data. However bills should be transparent and easy to understand. A consumer may prefer to access the disaggregated billing information in other places than on the bill, for example on a personalised website.

Demand side flexibility does not require home or business automation but automation increases the flexibility of the loads. Aggregation service providers and suppliers therefore tend to offer automation technologies as and when they see that the increased flexibility will pay for the extra implementation costs, or as the interest of the consumer grows. It is up to the consumers to decide what type of contract they prefer and to agree with its aggregation service provider and supplier whether mandatory or voluntary response is best suited to their needs.

Consumer access to organized electricity markets

When a customer signs a contract with a third party aggregator, the consumer gets access to whichever organized electricity markets in that Member State (day ahead, intra-day, balancing, capacity, etc.). Through this contract, the customer can sell the value of its consumption flexibility and/or injection to the third party aggregator, who can bid it into the market. Within the market, the injection or shifted or curtailed consumption is treated as a

MWh of electricity (energy). Meanwhile, the consumer is also served by a supplier and a BRP.

Somewhere between years-ahead and real-time, the aggregator has offered flexibility into the market. As required, the supplier has sourced an amount of energy in the day ahead market that is equal to the forecast of its customers' demand. Hence, the BRP perimeter is balanced. When a demand response dispatch occurs in real-time that is not initiated by the supplier, it changes the actual consumption of its customer base. This creates two distinct impacts:

- The BRP cannot charge or receive payment for part of the electricity it sourced on the market[21] (this electricity is consumed by clients of other suppliers).
- While the BRP is required to balance its portfolio, it is put in imbalance due to the third party aggregator action.

That said, the customer has, through the aggregation contract, sold the value of its demand side flexibility to be used into the market directly, and the customer should have the right to the market value of that flexibility.

In a competitive balancing (reserve) market, a wide range of resources should be able to compete on an equal footing – not only selected forms of generation. For example, a reserves market typically requires demand or supply to be available between ½ - 2 hours. However the participation requirements may state that load must be available for up to 12 hours[22]. Care should be taken in considering domestic consumers consumption as a controllable load, there will be still some uncertainty around the actual response and the likelihood of a positive response being linked to the value of the price signal.

Treatment of aggregated consumer load – single resource

Aggregation is only beneficial to consumers if the aggregator is able to transform multiple small chunks of flexibility resources into a product that is tradable on the market. For this purpose, the aggregator must be able to fulfil registration, prequalification (if relevant), measurement and communication required in these markets, as if they were a single power plant in the place of the individual consumer. In order for aggregation to be effective, the aggregated pool of load must be treated as a single resource. Pre-qualification, verification should wherever possible be performed at this pooled level.

When some resources of a portfolio are connected to grids of several DSOs, it is not realistic to locate the prequalification at the pooled level on the aggregated load. Each DSO will perform the prequalification studies on the resources connected to its own grid.

Protections and empowerment for domestic consumers

To protect and empower domestic consumers, actors in the energy market need a better understanding of their consumers. The actors need:

[21] Depending on the imbalance settlement regime of the Member State, they may or may not receive adequate payment for the energy sourced but not sold.

[22] For example, if demand side resources wish to participate in the secondary reserve markets, the requirements in Germany are that those participating resources need to be available and potentially be curtailed up to 12 hours.

- a better understanding of how consumers can be enabled to understand and compare;
- a better understanding of suitability of particular price offers to consumer groups, and steps taken to manage detriment where consumers sign up in error - shows need for distributional impact assessment (DIA);
- clarity on approach to incentives to engage consumers including the level of savings available to consumer segments and the behaviour changes needed (DIA); and
- to ensure reward to consumers for behaviours without extra penalties on those unable to engage.

The consumers need to be put in control. The consumers need for example:
- the right to opt in and opt out at any time;
- interoperability (with limitations clear at point of sale);
- link to usability of heating controls and energy efficiency programmes;
- clear regulatory framework for automation in relation to the meter (e.g. security, remote access) and safety concerns, clears rules on accessible and free override control;
- update product labelling to give info in a smart world;
- accreditation schemes (supported by regulatory oversight) to guide consumers to trusted/-worthy third parties;
- updated switching rules to accommodate different contracts (also if separate contracts for supply and flexibility);
- feasible models for limiting their liability when contracting with an aggregator or supplier;
- product standards; and
- access to redress any errors.

It is necessary to ensure consumer inclusivity. All should have the chance to participate and there should be protections in place for those that are unable to. The impact of demand side flexibility options on all domestic customers and especially vulnerable consumers need to be considered, so that the benefits are shared appropriately and no one is adversely affected. Vulnerable customers may need additional protections. Innovative solutions should be sought to ensure consumer protections are adapted and not relaxed to accommodate demand side flexibility options.

2.4 Measurement and verification requirements

Well defined and appropriate measurement and verification protocols are needed to realise cost effective market coordination. Smart meters are necessary to allow the amounts to be allocated to the BRP and then settled in the settlement process if aggregated flexibilities want to participate in markets.

The need for measurement, verification and baseline (see below) is not the same in the case of price-based demand response and volume-based demand response. If price-based, there is no need to control if the consumption pattern has changed, there is only a need to measure the energy consumption.

Measurement with an interval a prerequisite

Measurement with an interval which matches the market intervals, used as the settlement time period (15, 30 or 60 minutes in electricity and at least daily in gas) is a prerequisite for customers' load and/or generation participation within a portfolio of aggregated units. This means the metering system is capable of registering consumption on balance settlement time period (e.g. 15, 30 or 60 minutes) and communicates the data to the TSO and BRP according to the balancing processes defined in the Member States (therefore not necessarily in real time). If the settlement process is carried out less frequently, e.g. once a month, data is needed once a month. These measurements can be used to allocate the right volumes to the right parties in the allocation process. Installation of meters with these capabilities would thus be necessary, provided that CBA results are positive.

If a customer has contracts with more than one market actor on a connection, there needs to be separate measurement and settlement. If the flexibility is not measured separately, there should be a standardised measurement methodology for flexibility in each Member State. The methodology should enable the allocation of the demand action of each service provider for a single connection. In order to enable cross border flexibility trade, there is in the longer perspective a need for harmonised EU wide principles and methodologies. This methodology should preferably be based upon smart meter data. For industrial customers these types of gas and electricity meters are already installed in most countries.

As regards the interval for collection of metered values, a balance needs to be found between the need for accuracy and speed of the information on the one hand, and the related metering costs on the other. Only when it is proved that existing means of metering would not be sufficient to measure flexibility provided by consumers, the aggregator should be allowed to provide the appropriate means of measuring that service. As regards data used for settlement purposes, that data needs to be certified by an independent third party, such as the DSO in most of the countries.

Hourly metering

Consumers should have the right to be billed according to their actual consumption, as well as have the right to (at least) request and receive hourly metering. This encourages suppliers and energy service companies to offer contracts and services built around spot market prices, such as dynamic pricing and home/business automation controls.

Baseline

One essential part of establishing a level playing field for demand side resources includes the use of an expectation baseline which determines, for the volume-based flexibility, the consumption that would have occurred "but for" the actions taken by the customer in response to dispatch notification. There are many different baseline methodologies in use, dependent on the market and product, and there is no "one size fits all" best approach. See annex 5 for further discussions on baselines.

2.5 Contractual arrangements

If contractual arrangements are necessary between market parties, they should be streamlined and simple, and reflect the respective costs and risks for all parties.

Contractual arrangements should allow consumers to access any service provider of their choosing without previous permission of the BRP or supplier. Consumers existing contracts with suppliers are continued and respected, as well as property rights of suppliers and necessary market procedures, e.g. for the balancing and transfer of energy.

In the case of demand response being activated by a third party aggregation service provider, the BRP/supplier should always be informed while protect consumer's privacy and commercial interest of aggregators. Standard contracts should be put in place to ensure smooth contractual process, fair financial adjustment mechanism and standard communications procedures between aggregation service provider and the BRP/supplier. When relevant, contracts, communication and money flows can be directed through an independent third party. In the case of flexibility being valued through supply contracts, this does not apply.

2.6 Financial adjustment mechanism

In addition to the contractual arrangements described in 2.5, a financial adjustment mechanism is required in order to enable competition allowing for customer participation. This is particularly relevant between aggregators and BRPs/supplier in the case of a demand response action being initiated by third party aggregators.

This mechanism should ensure that all the electricity sourced on the market and consumed by end-customers is paid to the actor who sourced it; and at the same time avoiding the BRP from having unfair costs incurred through the fulfilment of its balancing requirements.

The financial adjustment mechanisms should as much as possible be applicable and symmetric for both regulation-up (demand curtailment) and regulation-down (demand enhancement).

Two main principles should be respected when establishing financial adjustments mechanisms:

- The financial adjustment for the energy sourced should reflect the sourcing costs.
- The financial adjustment should ensure that risks and costs are directed to the party that causes the risks and costs.

2.7 Telecommunications aspects

The development of smart grids, smart meters and smart markets presumes the combination of telecoms infrastructure and the electricity infrastructure. Telecoms should be considered as a main infrastructural asset for the development of smart grids and, hence, also of flexibility. There are many different telecom services and many different ways to organize them. Some services are already available and are managed well, are secure both at physical and application layers and are able to integrate and manage the data related with the operation of smart grids. Others may need to be developed specifically for smart grid services.

The deployment of smart grids might also create opportunities for the energy and the telecoms sector alike as to the creation of cost synergies, if a parallel deployment of high-speed broadband infrastructure takes place[23]. Models for a fruitful co-operation between energy utilities and telecom operators already exist in several Member States. Such co-operations are often carried out on commercial basis without any regulatory intervention.

In this field, EU measures for enabling cross-sector synergies between energy network operators and telecom operators were recently approved. A swift and proper implementation of Directive 2014/61[24] could facilitate cross-sector cooperation and new business models allowing cheaper deployment based on synergies between smart grids and broadband roll-out. A set of possible streamlined commercial arrangements between DSOs and telcos need to be identified in order to facilitate these synergies.

DSOs, telcos and ICT companies should be encouraged to identify the favourable business, regulatory and technological environment. Telcos, DSOs and other energy providers should define measures needed to establish a mutual trust as a key component underlying future collaboration. The process of conclusion of agreements by DSOs and telcos should be facilitated, with efficiency gains for both sectors.

DSOs are the party responsible for grid stability and thus they have to have the power of decision, within their responsibility area, about ICT solutions and cooperation partners. Any incentives should not limit the freedom of choice for DSOs in that context.

Work on contractual clauses, rules and procedures (liability, safety, maintenance, possible cost-sharing arrangements) could facilitate cooperation and would pave the way for achieving synergies between the telecom and utilities sectors for the smart grid and broadband deployment in line with the objectives of Directive 2014/61. Measures should favour and enable synergies at both infrastructure and services level, where partnership with telecom operators could lead to cost-efficient solutions.

3. Roles and responsibilities

To enable a flexibility market the roles and responsibilities must be clear, especially when recognizing that one company can fulfil more than one role. There needs to be an appropriate balance between incentivising consumers to participate in demand response and incentivising BRPs, TSOs, DSOs and aggregators to use it. Proper pricing signals for flexibility will ensure that balancing can be undertaken in the most efficient way and should strive to ensure that the consumer receives the real market value for participation, so that benefits are properly shared amongst all network users. Below we describe the roles and relations in a future market for flexibility services. Figure 2 shows possible relations between the market roles.

[23] To this end, measures at the EU level aimed at improving the regulatory framework for electronic communications with a view to better incentivising private investments in the roll out of NGA networks could have a beneficial impact.

[24] Directive 2014/61/EU on measures to reduce the cost of deploying high-speed electronic communications networks.

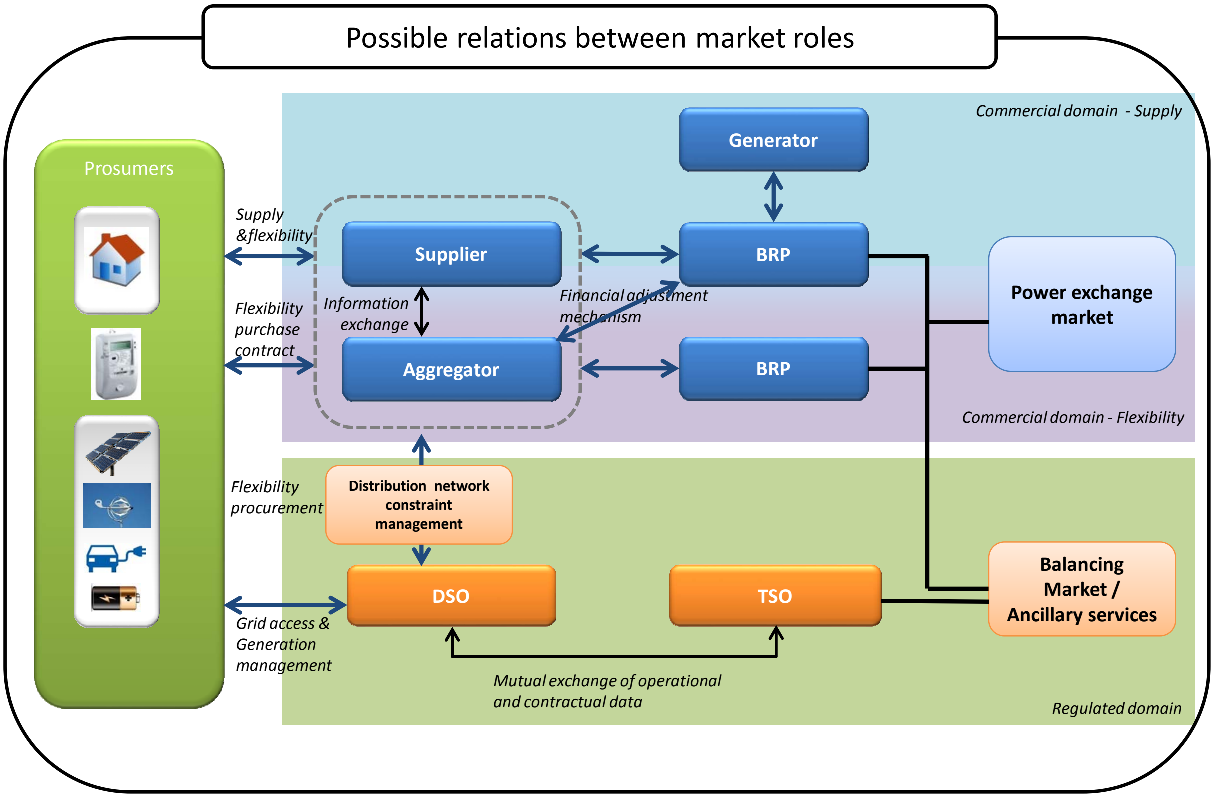


Figure 2. Possible relations between market roles.

3.1 Role of the Aggregation service provider

The aggregation service provider role can be taken by a third party aggregator or by a supplier.

When an independent aggregator is a third party their contractual and legal relationship to other market players is undefined in most Member States. For example, an aggregator may be required to establish more than one contract per consumer: these can be separate contracts with the BRP, supplier, TSO, DSO, and the consumer. Each of these will have their own, possibly contradictory, requirements and most will require payment. This could block the aggregation resources from being offered.

Clear and fair contractual and communication requirements need to be developed, both for existing and new parties. This is especially evident in the relationship between the BRP (often a generator and supplier) and the aggregator or BSP. In order to avoid barriers to entry, an aggregator should never be obliged to negotiate its portfolio with the BRP or supplier of a consumer. The consumer should have access to the best demand side flexibility offers available and to the service providers of their choice.

3.2 Role of the Balance Responsible Party (BRP) and Balancing Service Provider (BSP)

All (aggregated) balancing service, energy and congestion management services have to be measured and arrangements needs to be in place so that there are no gaps or overlaps between market participants' responsibilities. Imbalances need to be fairly assigned and the correct energy be assigned to the correct portfolio.

To ensure consistency of imbalance settlement and grid management services, the data and processes must be reconciled using the same meter (at the point of delivery) in order to settle imbalances due to non-balance responsible actors. Hence, the balance responsibility must be unambiguously defined in relation to all market parties that are supplying/receiving energy and/or invoking flexibility on that connection.

Certified metering data is necessary to allow the amounts to be allocated to the BRP and then settled in the settlement process, if aggregated flexibilities want to participate in balancing markets.

Any reduction or increase of demand or decrease and increase of local production behind the meter of a customer, which is not measured separately and which is initiated by a third party aggregator, could result in an imbalanced situation for the BRP and the supplier, if not taken into account properly in the settlement process.

Conversely, when a demand side flexibility event occurs with the participation of customers of a given BRP, and when the event is not initiated by the BRP itself, the BRP will upfront purchase on the wholesale markets volumes (of electricity and/or demand response) it cannot bill for, as these volumes were not used by its clients, but rather the flexibility were sold into, for example, the wholesale or balancing markets. In the case the BPR bought electricity, this electricity is consumed by clients of other suppliers.

The BRP would need a financial adjustment mechanism for electricity sourced and not sold, to reflect the sourcing costs. The financial adjustment should ensure that risks and costs are directed to the party that causes the risks and costs.

If a demand response activation benefits a BRPs balancing position, such earning should be shared with the demand resource that provided the flexibility. The BRP assumes responsibility for deviations between energy supplied and energy consumed within a balance portfolio. The BRP may therefore purchase electricity and/or provide services required to keep balance in its own portfolio. When flexibility resources participate in the wholesale or balancing markets, electricity may be accounted for as being redirected to the TSO.

Balancing services to a TSO can only be supplied by balancing service providers or, dependant on the balancing regime in the Member State, a party contracted by the TSO. (This does not hinder that one company acts as both BRP and BSP.)

It's possible that a BRP is linked to an aggregator, much like a supplier, and that all the actions of the aggregator lead to an increase or decrease of the production or consumption part of the portfolio of the BRP without requiring any direct intervention on the markets.

The role of the BSP is an important role in the balancing regime. An aggregation service provider can be a BSP, but the aggregator role can be wider if it offers products outside the balancing market. On the other hand, the role of the BSP is also wider than the role of an aggregation service provider.

3.3 Role of the Supplier

The supplier offers energy supply and may also provide flexibility offers. It is important to note that the supplier can offer dynamic pricing, feedback and also home automation program options for all consumers, including commercial and domestic consumers. As such they have a critical role to play in empowering the full range of consumer flexibility.

3.4 Role of the TSO

As the main role of TSOs is to ensure the overall system security and guarantee frequency system balancing, TSOs have a very important role in enabling demand side flexibility to develop. Because of their responsibility they decide, in many Member States, the program, prequalification, measurement, verification and communication requirements within the balancing and ancillary services markets. They should also ensure transparent and fair pricing arrangements.

The TSO (and the DSO) acts as a neutral market facilitators between aggregators, BRPs and suppliers, providing the communication and settlement services. As the balancing markets are usually the first point of entry for investment in large scale demand side flexibility, the extent to which a given TSO takes on its responsibility to ensure fair competition within its markets, (enabling balancing services at the lowest possible cost while maintaining system security) will to some extent decide the overall level of investment in flexibility services within a given Member State.

As these markets develop it will be increasingly important that TSOs and DSOs communicate and coordinate their actions and exchange relevant operational data with each other. Provided DSOs are not closely linked with a BRP, TSOs will need to report to the DSOs concerning existing flexibility contracts and activations in the respective distribution grid area (insofar as this information may be relevant for DSOs and provided they are not competitors in the field of demand response nor linked to such competitors).

DSO constraint management will also affect the TSO grid and balancing of the system, therefore, constraint management procedures need to be in place. And like the DSO, the TSO must have access to all technical relevant data needed to perform their activities both at pre-qualification stage and in real time (or close to real time).

Modifications of relevant activation of flexibility by DSOs or TSOs shall be exchanged with each other in advance, before the selection of the flexibility to be activated. Regulated revenues should integrate the recovery of these costs in a way that does not distort the optimal economical arbitrage for the system between distribution and transmission system grid reinforcement/development versus costs of managing grid congestions without this grid extension.

3.5 Role of the DSO

DSOs (and TSOs) have the possibility to optimise investment in networks through the use of smart grids, including demand side flexibility. Flexible grid access and real-time flexibility can reduce or postpone investment needs. The DSO role in flexibility can co-exist along-side a supplier (or other party) data management model provided it is properly regulated. DSOs should have the opportunity to use flexibility services where this provides a benefit to the network and hence to the consumer. Through proper regulation DSO customers can benefit from new services which can enhance competitive markets.

Activation of flexibility located in distribution networks for the purpose of system balancing, portfolio optimisation or transmission constraints management may lead to constraints in distribution networks and affect security of supply and quality of service. Given its responsibility of ensuring the security of the grid, the DSO should be involved in the different stages of flexibility activation. DSOs may need visibility of the planned aggregation actions connected to their networks. This would ensure that market schedules are not in conflict with network operation and to seek mitigation actions either through commercial flexibility services or internal network control actions depending on the state of the system.

A prerequisite necessary for the DSO's role in flexibility is to increase the real time monitoring ability and controllability in the medium and low voltage distribution grid. The next step would be to include decentralized generators, the charging processes of electric vehicles and consumers in real-time smart grid operations.

Non-discriminatory access to data is essential for a functioning energy market and operation of the distribution network. The data manager – the DSO in many Members States - should equally provide to all market parties, new and existing, sufficient, differentiated and timely data via appropriate market facilitation services.

For grid operators, suppliers, BRPs, consumers, generators and storage operators and - if authorized by the customer - for any third party it has to be assured that all data is only used for the proposed use. Data security is self-evident; all parties having access to the data are obliged to respect data privacy. To enhance data communication, internationally accepted open and interoperable standards for interfaces should be in place.

In Member States where the DSO is the data manager in delivering metering data to market parties, DSOs perform the function of "closing the information loop" (see figure 3); market parties will deliver all new type of services to customers, subsequently customers will use these services, combining them with their own capabilities (PV, EV, consumer energy management), leading to a behaviour and usage which is measured by DSO's, who will then with customers consent pass on data reflecting this usage/behaviour to market parties.

When this information, well defined and sufficient to serve market needs, is fed back as a service to market parties, the "information loop" is closed[25]. In this way DSO's contribute to customer empowerment, market growth and market competition and maintaining a level playing field between aggregators and suppliers.

[25] See the concept of energy grid services, P.Hermans, EG3 http://ec.europa.eu/energy/gas_electricity/smartgrids/doc/xpert_group3_energy_grid_services.pdf

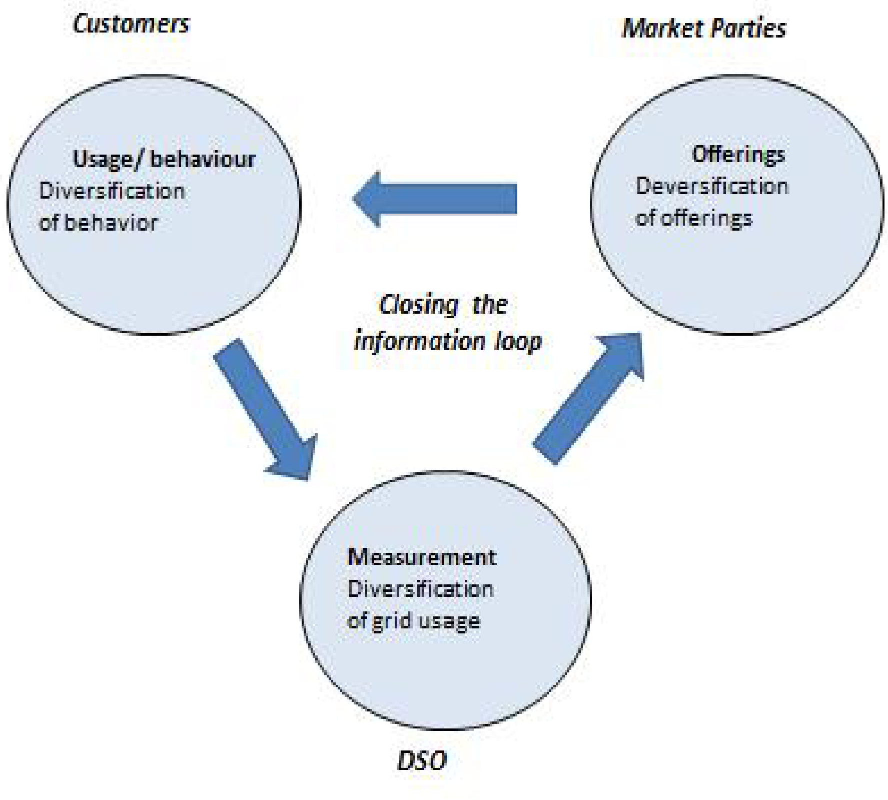


Figure 3: Closing of the information loop.

3.6 Role of the Regulators – Energy and Telecom

Demand side flexibility might require investments that need to be covered by grid tariffs. As telecommunication is an important asset for flexibility, specifically this may require considerable investments. However, since many solutions seem to be commercially available and, where needed, may be developed tailor made, there seems to be no need for regulatory intervention from the side of telcos to foster the deployment of smart grids or smart meters. Also, there seem to be no clear immediate regulatory problems at this moment from the viewpoint of telcos when developing smart grids. (Some) requirements of telecommunication regulatory law might apply and, hence, have to be respected, when smart grids are rolled out.

The challenge for energy regulators might be to determine the most efficient and effective way to deploy ICT for making the grid smart and consider the right costs when approving grid tariffs. Also, energy utilities may engage in the development and roll out of telcos infrastructure, either by using existing infrastructure or in cases where new energy infrastructure is deployed.

The energy regulators role in relation to the recommendations to follow further down is as follows. NRAs:

- will ensure that essential technical requirements are fulfilled by the new service providers for a well-functioning market;

- should enable the creation of simple contractual arrangements, allowing consumers to access any service provider of their choosing, without previous permission of the BRP or supplier;
- should work together with the European Commission to develop a number of relevant financial adjustment mechanisms facilitating further integration of the different EU energy markets and allow demand side flexibility to participate on a level playing field. Market rules should be holistic and developed in close cooperation with stakeholders, including aggregators, BRPs, consumers and suppliers;
- should ensure that data managers equally provide to all market parties – new and existing - sufficient, differentiated and timely data via appropriate market facilitation services, while respecting customers right to control access to their data. NRAs should in these regards ensure how costs are recovered;
- should ensure that consumers should have the right to (at least) request and receive hourly metering;
- should ensure that DSOs and TSOs are given the tools necessary to improve the efficiency of their networks, based on market rules and when efficient, while at the same time maintaining their position as neutral market facilitators, where applicable in Member States;
- should together with consumer protection agencies seek innovative solutions to ensure consumer protections are adapted and not relaxed to accommodate demand side flexibility options; and
- should, together with the Commission and Member States, encourage DSOs, telcos and ICT companies to identify the favourable business, regulatory and technological environment.

Chapter 3: Incentives.

1. Introduction: Objectives and scope

Functioning markets with flexibility will only develop if there is an added value for the customers and all market participants see a business case in developing the products and services while the markets sustain themselves without subsidies. The task of the policymakers is to prepare a level playing field for all market actors in the existing energy (gas and electricity) markets and to allow new market segment(s) to develop so that positive economic value for society as a whole can be generated. The market design should define fundamental rules for fair and clear market functioning. Market design should be clearly separated from incentives and incentives should interface with the energy market in the best possible manner.

The use of incentives may be considered either to:

- kick-start a new market – for example, by enabling future flexibility markets by investing in necessary technology - or
- introduce changes to the existing markets – for example by facilitating access of new players - or
- ensure efficient investment decisions continue to be made and innovative solutions continue to be adopted / implemented in the long term (though output based incentive regulation mechanisms) - or
- contribute to consumer behaviour change programmes.

In general, incentives should be used only when there are externalities or other market failures that justify their use as a tool to maximize societal benefits. In order to be efficient and legitimate, incentives should be limited in time, proportionate and target a specific objective. Targeted objectives can be technical (e.g. to deploy a new technology that is perceived as profitable for the society), societal (e.g. to protect vulnerable customers), political (e.g. to safeguard competitiveness of the European industry, to ensure energy independence of the EU, etc.), environmental (e.g. 2020 and 2030 objectives) or to ensure efficiency. When the objective is clearly stated, it is possible to assess the incentive's efficiency and the impact. Incentives should not lead to market distortions.

Who and what needs to be incentivised by whom? What kinds of incentives (if any) are needed for which actors? How to incentivise in a way that the value for the customer is optimised while maintaining the high quality of service?
The objective of this chapter is to identify what incentives are needed for transition from the current to the future state of using flexibility, namely:

- What types of incentives are available and how to assess whether the need for incentives is justified? (section 3.2)
- Who may have to be incentivised and why? (section 3.3)
- Which areas of business may need to be incentivised and how? (section 3.4)
- Who should deliver incentives? (section 3.5)
- Investigate good practices (section 3.6)

Section 7 summarizes the key findings.

2. Need for incentives

2.1 Understanding of an incentive:

An incentive is a cost or benefit that motivates a decision or action by consumers, businesses, or other commercial and regulated parties. Incentives aim to provide value for money and contribute to reaching set objectives. Incentives can be created temporarily (short term) or to support long term strategies. Incentives could be targeted on specific consumer groups, on regulated entities (e.g. grid operator), or on non-regulated entities (commercial market parties).

This paper discusses incentives that are either explicitly created by government policies or regulation (different authorities/institutions can be responsible for incentives in countries) to achieve the desired objective, i.e. efficient market functioning and tapping the potential value of flexibility for the customer. Incentives can be also created by specific non-governmental stakeholders. In case of the government and regulators, the objective would be two-fold: on the one hand, to make sure that specific barriers that those incentives address are removed; on the other hand, to guarantee the compatibility of the different incentives/schemes in place. Coherence of different incentives is necessary in order to guarantee that a package of incentives provides the right signals.

2.2 Differentiation of incentives:

Which types of incentives are available? Subject to a CBA, overall impact analysis and ambitions set, the following types of incentives could be considered:

- Subsidies can be provided by the state or other public authorities. These can be given directly to the end user or beneficiary or indirectly through a third party.
- Tax benefits and reliefs such as the possibility to deduce purchases of smart appliances from the income tax or a reduced value-added tax (VAT) can only be given by the state or local governments (where applicable).
- Financial instruments at the EU or national level such as low interest or specialized loans or project bonds to attract additional private finance from institutional investors.
- Access to funding at the EU or national level such as an innovation fund to support both pilot and demonstration projects can be supported e.g. to facilitate deployment of smart grids solutions. State can reward new inventions, offer research funding for university and companies etc.
- Regulatory incentives such as “quality of investment” indexes for remuneration formulas or decreased amortization periods.
- Sustainable procurement such as Green Public Procurement (GPP) on the basis of life cycle costing at the member states/public authorities level.
- Information and customer engagement programmes such as communication campaigns at national level (supported by policymakers, i.e. not left to the industry alone) can help create customer awareness about benefits and opportunities offered by the new solutions and tariffs. In addition, market players can map customer journeys during their business planning in order to identify incentives for the respective customer groups.

The level of the incentive should be set at a level consistent with achieving the desired outcome at minimum cost. Therefore quantifiable goals should be defined, propositions tested, schemes trialled, and outcomes measured, so that necessary refinements can be made. Furthermore, an assessment needs to be made as to the time span of any intervention, and for temporary incentives, phase-out plans need to be identified. Furthermore, support mechanisms should be consistent with the EU competition rules (including state aid guidelines).

As stated in section 1 the motivation for flexibility incentives is to kick-start the new flexibility market and to overcome potential financial, regulatory or psychological barriers of customers and other market actors to access existing markets. Reasons for "incentivising" must be easily understandable for customers, i.e. benefit of incentives must be clear.

2.3 How can the need for incentives be measured? How to evaluate whether incentives are justified and effective?

Member States should assess, under guidance of the European Commission, the Demand Side Flexibility (DSF) potential (realistic vs. theoretical) including how flexibility generates value and how the created value is shared between different parties. They should also analyse which DSF potential is currently used, how the created value can reach customers, what would be the consequences of using that untapped potential on efficiency increase, and what upfront investments will be necessary to tap realistically achievable potential without incentives. Assessment of this technical and economic potential and the factors preventing its realisation will determine what the needs for incentives are with respect to the targets set. Impact on the market and on competition as well as on prices including the distributional effect on different social groups should be considered when setting incentives.

It is important to undertake an assessment of the forecasted impact of the incentive scheme. Cost benefit analysis (CBA) on Member State level are essential and will be challenging. Qualitative and quantitative impacts should be assessed. If it concerns a specific technology, a cost-benefit analysis should also consider the maturity of the technology. For example, market incentives can only apply to products available in the market while emerging technologies would benefit more from R&D incentives. In any case, potential market distortions should be assessed and avoided.

The following sections evaluate which actors may need incentives, for what and why and under which circumstances granted incentives are to be phased-out.

3. Who may have to be incentivised and why?

3.1. Network companies in the energy industry

The increasing amount of DER injection of all sizes, combined with the expected development of flexible loads at all levels of consumption, will make the electricity system much more complex to plan and balance. Grid operators need to ensure that their networks can accommodate the increasing loads from electric vehicles and heat pumps as well as distributed generation. Technologies to avoid overloading the network and avoiding interruptions or technical violations (voltage control, network restoration etc.) and inefficient reinforcement and reducing network losses are already available but have yet to be introduced into distribution networks on a large scale.

To do this, grid operators should be incentivised to make efficient investments that are needed to facilitate service continuity and to deliver safe, reliable and sustainable services to customers as well as enabled to procure flexibility for management of congestion in their grids whenever it constitutes an economical alternative as outlined in previous chapters. In this sense, DSOs should develop adequate tools to assess technical parameters related to flexibility sources namely their network local impact, in coordination with the TSOs. Where responsible for collecting data, grid operators should be enabled to act as a neutral market facilitator by providing relevant data to all relevant parties.

Grid operators are regulated entities that have to cover their capital cost (CAPEX) and operation cost (OPEX) via regulated revenues which are collected via network tariffs. Sustainable and efficient long-term regulation needs to strike a balance between price adequacy for consumers, quality of supply and a viable framework for distribution companies.

The regulatory framework will thus play a key role in promoting a step change in the way grid operator think about accommodating uncertain levels of low carbon technologies onto their networks. Grid operators should be incentivised to make efficient long-term investments rather than focus on short-term optimisation.

The right package of measureable outputs and incentives should ensure that regulated entities do this at an efficient cost, using flexibility whenever it is a cost-effective and stable alternative to conventional solutions whilst providing good service to new and existing network customers (grid users). In most European countries, regulatory schemes include some elements of so-called “incentive regulation”. In the future, grid operators should be able to postpone or reduce investments for capacity upgrading of the grid through flexibility measures if such solutions turn out to be more cost-effective and do not compromise security of supply and quality of service. If efficiency requirements are set only on OPEX, grid operators are not incentivised to pursue operational solutions such as the use of flexibility as it would lead to lower return on capital. Therefore it is necessary to adjust regulatory regimes in all dimensions (i.e. in terms of setting costs, revenues and grid tariffs). Regulatory schemes should be technology neutral.

In addition, new techniques and methodologies, for instance contractual and procurement solutions, business models, technical solutions, communications solutions, will be needed to maximise the efficient use of different technologies integrated into the power system. This list is neither prescriptive nor complete as the holistic nature of these different approaches is the most important element to be considered.

Member States should encourage the implementation of efficient and effective ways to deploy ICT infrastructure for smart grid management also by incentivising synergies with appropriate stakeholders when this is an option (e.g. the telecommunications sector) while taking into account the high security levels necessary to guarantee a secure and stable grid operation.

Member States and NRAs should work towards creating a favourable business, regulatory, and technological environment for the deployment of smart grids. They should encourage also the identification of solutions to utilize existing telecommunication infrastructure and models of cooperation between the grid operators and telecom providers in the development and operation of new systems where appropriate.

It is of utmost importance for the communication infrastructure for network operation to avoid unauthorised access of third parties and prevent cyber-attacks. When operating electricity grids, high security levels are necessary to guarantee a secure and stable grid operation. The transmission of signals to open and close circuits or breakers at smart meters and collecting individual customer data are important examples of communication needs for a DSO. Both those activities are very sensitive where security risks must be avoided even at extra cost (an adequate solution could be a closed dedicated communication infrastructure only for grid operation purposes).

The provision of infrastructure access by utility operators could be made more attractive by including costs stemming from provisioning that service into the cost basis for the calculation of tariffs for their main activity. The provision of access could also be made more attractive by enabling the regulated energy network company to keep some of the reward or introducing higher incentives to reward shared use and parallel deployment of infrastructure (e.g. using utility owned passive infrastructure).

Member States should incentivise the most efficient use of available resources before new infrastructure is considered. This is not restricted to a pure evaluation of cost as other factors such as the solutions resilience (e.g. diversity of communications routes and use of media), physical and cyber-security, ability to fulfil the required functionality and operational and maintenance considerations. The cost of working round any of these listed issues could dissolve any cost savings by transferring the cost from CAPEX to OPEX.

To this end, well developed telecommunications infrastructure is widely available, which presumably could be used for the roll-out of smart grids under commercial conditions, while security reasons and the energy networks classification as a critical infrastructure, if applicable, could require a separate telecommunication infrastructure for in-grid purposes. Whether a separate infrastructure is necessary or not relates primarily to the actual requirements of the energy sector, i.e. which technical and quality feature the telecommunication infrastructure eventually must fulfil to be suitable for smart grids and smart meters.

If publicly available electronic communications networks serve the requirements by energy utilities, the question whether it would be acceptable that costs for the deployment of a separate telecommunication infrastructure are borne by the end users might arise. Taking the above into consideration, Member States should also avoid market distorting through regulatory measures that would treat preferentially investments in new infrastructure rather than solutions build through partnership with Telcos and use of their infrastructure in the case that both options can meet the requirements of the energy company at the same costs. Anyway, energy network companies are the party responsible for grid stability and thus have a responsibility with regard to ICT solutions and cooperation partners. Therefore, incentives should take into account the necessary freedom of choice for energy network companies in that context.

3.2 Competitive activity that is regulated

Regulated prices for all consumers should be progressively phased out, in line with the European Commission's recommendation COM(2012)663. Their continuation is unlikely to encourage development of DSF.

3.3 Non-regulated companies/ competitive activities in the energy industry

The Member States should create a market environment which enables the full range of flexibility options as described in Chapter 1 on Flexibility.

Flexibility from both demand side and generation resources has to be integrated into the energy market design and allowed to compete on a level playing field, as described in Chapter 2 on Regulatory & Commercial Arrangements. This may require an amendment of grid access, balancing and metering rules and contracts and removal of any additional market access barriers for flexibility at Member State level etc. (see Chapter 2 and section 5). In order to increase the available flexibility, also the small sized generation will play an important role and the participation in markets of these technologies must be incentivised. The new Energy and Environmental State aid Guidelines (EESG) adopted in April 2014 by the EC encourage Member States to ensure that RES production increasingly reacts to market signals. It recommends to the Member States to start implementing competitive bidding procedures for a small share of their new RES capacity and obliges them to use as support instruments market premiums – a top-up on the market price – or certificates in order to promote the better integration of renewable energy into the market.

In other words, Member States shall ensure that the market rules provide the incentives to parties to operate in the market in an efficient way. It would then be for each party to decide how to achieve this objective. Offering flexibility services to customers could then be a part of the strategy for differentiation and competition between suppliers and other market agents.
Besides that, non-regulated companies are not expected to need any incentives as a starting point to procure /sell flexibility as long as they are able to harvest sufficient benefits from it and are able to procure energy differently, sell flexibility to third parties etc.

3.4 Customers

All customer groups need qualified and neutral background information about the opportunities offered by the energy market from making their flexibility available. Customers need information about developments in the market design and clear information about options, possibilities, costs and benefits of offers allowing them to compare market opportunities. It is up to customers to accept a commercial offer or not. To be more active customers must see benefits, as this may lead initially to more work, higher risk and investments in equipment/appliances.

The customer can be incentivised to provide flexibility either by commercial parties like aggregation service providers and/or suppliers supported by the regulated parties (e.g. through network tariffs – see 4.3). However, in most European countries taxes and levies represent a significant share of electricity prices paid by end-consumers. This fixed part of electricity prices hampers the price signals being sent to customers for demand response. Indeed, while the energy element can reflect market prices, the taxes and levies elements remain fixed. The progressive removal of a number of taxes and levies from the end-user electricity prices is a way to incentivize non-regulated companies to develop more efficient demand response programs, e.g. via dynamic pricing.

In addition, customers wishing to connect to the distribution network could be incentivised by price signals to opt for smart grid solutions which would avoid or defer this investment until there is certainty on the level of future demand. Cost signals could incentivise connecting customers to locate in areas where there is spare capacity on the network, and reduce the risk of the wider customer base paying for underutilised capacity.

The incentives for the various customer groups will differ.

Residential customers will only be active if the involvement is not too complicated and if they see a benefit. Smart appliances, smart home automation and more intelligent solutions to easily manage energy in the home in general, will minimize consumers' efforts in dealing with the opportunities offered by the future energy market. This would have to be accompanied by appropriate new protections to ensure that automation does not compromise autonomy, accountability or reliability.

But replacement of existing appliances with the new smart products may take a long time, since consumers may not be willing to dispose of still perfectly working appliances simply because of the economic benefits offered by taking part in the energy markets. In order to speed up the acquisition of smart appliances by the end consumers, and so doing acquire installed products that can be relevant for the grid both in terms of flexibility and efficiency, smart appliances could potentially receive incentives in the early stages of their development to reduce the initial acquisition cost for the end users. However, the case would have to be made that this expense would deliver a clear benefit to all consumers. Alternatively, smart home automation equipment can control some of the existing appliances (mainly water heaters and some heating, ventilating and air-conditioning - HVAC) to an extent that the effort of investing in brand new appliances could be avoided.

At present, commercial and industrial customers often actively manage their demand. They will only react if they see a commercial benefit in a defined timeframe. Investment in new machinery and IT is often needed.

Tax reduction programmes can be a good incentive for different types of customers but also grants by third parties should be considered and allowed.

Last but not least, the rapid cost decline of some decentralised energy generating technologies is opening-up new possibilities for consumers. Residential but also industrial consumers now have a choice between buying electricity from the grid and producing it themselves. These so-called “prosumers” will also provide the system with new sources of flexibility: by self-consuming (instantaneously or later during the day) the energy self-produced, they have increased capabilities to modify their load profiles, provide grid support services etc. Any regulatory or technical barriers for prosumers and self-consumption which do exist today in several countries should be lifted.

3.5 Telecom, ICT, Manufacturers

IT and telecom will constitute a crucial enabler of smart grids and markets where flexibility should be able to participate.

All market actors like grid operators, aggregators and suppliers will need to use ICT and telecom products in new and innovative ways to resolve some of the power system challenges. The importance of ICT and telecommunications, especially for grid management, means that ICT and telecom solutions to enable monitoring and control is growing for grid operators at ever lower voltages in their networks. Different reliabilities, latency, security and operational priorities could be needed depending on the use-case (e.g. use-cases necessary for a black-start). Communications and intelligence that is both central and distributed is likely to be needed to resolve many of the technical challenges to enable the required smart market benefits that are desired by the flexibility functionality.

It should be left to these actors to choose which ICT or telecom products and partners they select or want to use to operate their business in the most efficient, safe and reliable way. In addition, each national energy and telecom market has its own characteristics which require different solutions.

However, when partnership between utilities and telcos for new deployment or for the use of existing telecommunication infrastructure may lead to more efficient solutions in the deployment of the smart grid infrastructure ensuring the necessary requirements, Member States should consider how to avoid potentially distortive regulatory incentives pushing towards new internalised infrastructure investments if other existing infrastructure or partnership with telcos could lead to cost efficient solutions (this is linked to the more advantageous treatment of new investment as opposite to the use of commercial agreements and existing infrastructure - CAPEX versus OPEX treatment).

The importance of the grid integrity and the license conditions imposed by regulation on utilities mean that there will be a need for careful consideration and evaluation of market structures. There may be efficiencies that can be gained from infrastructure sharing. To achieve this, Member States will need to be cognisant of the barriers to success and will need to ensure the market structure is fit for purpose to allow risks to be managed and cost apportioned appropriately. This will allow the parties to voluntarily share infrastructure where this makes sense in a much less prescriptive manner. A good example of where this has been achieved is the Netherlands where spectrum, asset ownership and operation have been divided between the utilities and telcos to major on their strengths. Another example is Luxemburg where fibre sharing and ducts have been arrived at by mutual benefit.

Member States and NRAs could promote the cooperation between telcos and energy network companies if this is considered beneficiary. However, since the energy network company is responsible for the security and availability of the grid and the security and availability of the services (like providing metering data) it should be able to make the decisions necessary to balance all requirements at an efficient cost.

This could mean buying the service from telcos or acquire a spectrum band and cooperate with telcos to create a mission critical reliable telecommunication infrastructure for utility purpose. This decision should depend on the business and technical needs of the energy network company.

Exclusive spectrum allocations for smart grid purposes to energy network companies or telecommunication operators might be a possible way forward to provide the utilities with the opportunity to control and ensure the (cyber) safety of the grid.

At the moment, it is not clear and commonly agreed whether an exclusive designation of spectrum for smart energy grids and or smart meters is necessary, particularly in view of the possibility for utility companies of very well using several already existing frequency options within their networks. The Radio Spectrum Policy Group (RSPG), which has been established by the European Commission, is currently of the view that ”… for smart energy grids, smart meters, […] *the RSPG has identified no requirements that would motivate a harmonised European solution for dedicated spectrum for specific services or applications […]. However, the large predicted growth within some of these analysed sectors contribute to an increased need and demand for capacity and bandwidth, which may be met in suitably expanded future identification of bands under general authorisations (exemption from individual licensing). The future spectrum needs for smart energy grids, smart meters, ITS and IoT (including RFIDs and M2M) can be addressed via the ETSI-CEPT process.*"

Manufacturers of smart appliances and of smart products that can be part of the home energy system in general will have a key role in creating the right products for the market and in maintaining them for their entire life since now they require to be constantly updated in order to be able to interact with the evolving Smart Grids and energy market. This scenario is to a large extent different from the current one, where many products are totally on their own once out of the factories.
To do this, manufacturers of smart products should be able to make investments that are needed to ensure consumers continue to receive safe, reliable services and support over time for their products that interact with the smart grid and their stakeholders.

Incentives, in particular in form of promoting interoperability of products and protocols, should facilitate a step change in the way manufacturers think about the future of their products and how they will accommodate the possibility to evolve over time onto their products and support infrastructures. In addition, appliances which implement useful flexibility functionalities should receive a higher energy efficiency label.

4. Which field of business may need to be incentivised and how?

4.1 Smart grids and smart metering as enablers of flexibility

The transition towards a smart grid is often described as bringing to the distribution grids the intelligence that has already been implemented in the transmission grids. However, the numbers of lines, transformers, nodes, customers and DER are higher in the distribution grid.

Investments in already existing smart grids technologies are needed to enhance the flexibility. At the same time, demonstration and pilot projects are vital to help the development of systems and concepts which are tailored for the grid’s specific conditions. The optimal level of monitoring, automation and control of the network has to be found that will allow coping with the future challenges and at the same time keeping the necessary network investments at an adequate level. New concepts for grid operation and planning are already there and need to be further developed to obtain maximal benefits from the smart metering systems. Demonstration and pilot projects are the best way to evaluate the benefits of innovative intelligent technology, to learn about customer behaviour and the barriers to be overcome, and lay the foundation for possible further deployment. In particular, demonstration projects will grow in importance to facilitate the further development of active grid management and operation.

When setting price control allowances or tariffs, NRAs have developed a wide range of incentive mechanisms. These have been focussed on reducing costs of grid operators and promoting efficiency. More recently, incentives have been used to encourage companies to improve the quality of service to customers and also to foster a more innovative culture in grid operators which considers flexibility. Despite that and the political will to foster smart grids, R&D and pilot projects are mostly treated like any other cost, i.e. there is no specific compensation for the risks involved in testing new technologies and processes. In some countries where specific regulatory mechanisms for such investments exist, it may be offset by extra cost-efficiency requirements. Efficiency requirements that are mostly based on historic cost do not take into account the general investment challenge as well as innovation needs. Methodological distortions when setting efficiency targets may further reduce their achievability and should therefore be eliminated. While regulation mainly focuses on cost reductions, pilots do not necessarily lead to short-term cost reductions and may have a negative effect on the efficiency benchmarking. Depending on the regulation scheme, costs are thus not or not fully approved by the regulator. The special risk structure would neither be reflected by the regulatory risk premium nor by the depreciation period. In order to fully take advantage of the new technology related to the smart grid, the regulatory models have to be updated in countries where this is problematic.

Innovation may also be encouraged through a Member State or NRA fund to sponsor projects which trial innovative technological, operating and commercial arrangements for flexibility. Remuneration and funding will constitute an important signal for grid operators to support their innovation in integrating the new sources of flexibility and their management from a system point of view.

List of specific country cases can be found in Annex 6 and external reports.

In most countries, DSOs will be responsible for the smart meter roll out, subject to positive CBA/Member State decision. More measurements are required when flexibility products or options are offered to the customer. As regulated entities DSOs have to be allowed to recover the corresponding cost for the roll-out and data handling through regulated revenues. Clear roll-out mandate and an appropriate regulatory framework is thus crucial. NRAs should also consider that smart meters will replace the traditional way to read the meters and its cost.

List of specific country cases for smart metering can be found in Annex 7.

4.2. Network investments in general

Besides investments in the networks for the deployment of smart grids in order to facilitate integration of DER and development of flexibility, it might be also necessary to have investment to replace components of the grids (transformers, cables, power electronics and other equipment) that are coming to an end of their asset lifetime and grid extensions. In other words, investments in the "traditional" components of the grids will still be needed.

The networks for both, gas and for electricity, need a stable, predictable and appropriate regulatory regime, supported by sufficient incentives for investors (grid operators and other parties whom grid operators may approach to finance their investments), to fund the necessary networks updating, for the deployment of smart grids under the framework of the Third Energy Package signposted to reduce the levels of uncertainty.

Sustainable, future-oriented and long-term perspectives are all essential as the grid operator business but also other market players have a planning horizon of decades, and the challenges are changing in line with the development of European energy policy to achieve the decarbonisation of the energy market.

4.3. Establishment of new flexibility services from demand side and generation

Flexibility demand response is an integral part of a consumer-centric market vision in the energy sector. Its role is foreseen in the design of the EU internal energy market calling for consumer empowerment. It is also needed to ensure a cost-efficient level of secured generation capacity instead of the traditional approach of meeting peak demand. In both wholesale and retail, demand response is centred on fair reward to consumers for demand flexibility and relies on available technical solutions.

Just as a diversified supply-side portfolio is considered beneficial, having different demand response options available to the whole range of consumers should be seen as an advantage for the energy system. Demand side participation must be treated fairly in comparison with supply.

Industrial, commercial and residential consumers must have the means of accessing the wholesale, balancing, reserves and other system services markets, either directly or through service providers. It is essential to create market structures which reward and maximize flexibility and capacity resources in a manner which provides investment stability.

In many countries, grid operators (mainly relevant for DSOs) are obliged to design their networks according to peak demand and in some countries grid operators are not allowed to contract flexibility as a grid service. In others, flexibility services are starting to appear that help avoid costly network capacity reinforcements that would be used only few hours per year. Grid operators should be free to consider both the traditional investment solution (building up new capacity) and the flexibility service-based solution, or a combination of the two, depending on what is most efficient. Member States and NRAs should remove any regulatory provisions that prevent grid operators from having the option to contract flexibility. Cost recovery should be assured by NRAs when grid operators purchase flexibility for grid services where efficient. National regulatory authorities should define, on the basis of a wide stakeholders' consultation, transparent, fair and clear boundary conditions for the provision of these services, market-based where possible. If customers or generators are affected in an active grid management the rules have to be defined in specific contracts or in the energy law e.g. for the curtailment of residential customers or the curtailment of RES in case of overflow. Development of schemes allowing connecting customers to reduce their costs through adopting smart technologies (such as variable network access offered as a discounted connection) should be also supported.

NRAs should also assess the treatment of flexibility investments. If flexibility avoids an investment, the value of flexibility then equals the avoided CAPEX and OPEX of the reinforcement. Usually flexibility only defers the investments but creates additional operational costs that must be recognised by the regulator. It should be also recognized that grid operators need flexibilities over longer time frames in order to be able to make good use of them, i.e. a relevant level of "firmness" is needed.

In addition, new tariff regimes for network users should be developed at Member States level to help unlock or further develop the flexibility potential of network users. Innovative network pricing, contractual options for flexibility services and dynamic pricing offerings from the market could incentivise customers to change their consumption behaviour. At the same time, the wider use of self-consumption and new loads will require a deeper reflection on appropriate, more cost-reflective grid charging to achieve an equitable distribution of costs between different consumer groups. Current grid tariff structures are often based on consumed energy. A development towards more capacity/power based grid tariffs provides customers with incentives to reduce their personal peak loads. Implementing flexible grid tariffs that are more cost-reflective (e.g. time-of-use based pricing) and evolve also options for variations of the energy costs could be another one way to incentivise market actors to actively use their consumption and/or generation patterns. Subsidizing the development of non-regulated activities through grid tariff distortions must be avoided.

In the future, market parties will have more requirements for data (more real time and more differentiated) that are created in the metering point and the grid (delivered by DSOs in some Member States) creating and adding value for customers and market parties. Therefore, DSOs and other market parties can define a set of energy grid services, and deliver data per energy grid service. If such an energy grid service would correspond one to one to a category of the load mix of the customer (e.g. basic load, EV charging load, or energy produced by customers & fed back into the grid), then separate demand side management services could be developed in the market for these different load categories.

This new concept of energy grid services might also enable the market to develop more enhanced products and services (e.g. per each load mix category), specifically tailored to incentivise specific customer behaviour or to address specific needs.

4.4. Development and Roll-Out of Home Appliances

Intelligent gas and electricity appliances will enhance the development of demand response on the residential market. Steering boxes for the control/monitoring of such devices can be offered by the various actors already today.

Technology in this area is rapidly evolving and new products will be created to meet the evolving needs by taking advantage of the technological progress. New skills and competences are needed in order to keep the pace in this race where Europe can get in terms of growth, jobs creation and technology. Demonstration and pilot projects incentives for manufacturers of these products and services are then key to support their competitive advantage and growth in the future.

The price of the boxes will depend on volume/take-up and the services they facilitate which are related to the regulation rules around the box and the availability of standardised communication between the box, the appliances and the smart meter. Incentives from the state to end customers are one possibility to incentivise customers, it this proves necessary. However, clearly defining the perimeter of such regulated activity is very important to avoid hampering the competition in home appliances market.

4.5. Machine to machine (M2M) communication in the energy system

In the future it is most likely that an in-home energy management system will be used either standing alone or integrated with other home automation functions and applications.

There are many M2M solutions, including ICT in smart grids and smart meters. The best technology solution fit depends on needs of the appliances/machines. In the commercial domain there are many different standardised options and possibilities.

Only if M2M communication products meet the special needs of a future-proof and secure energy system will the services be attractive. Market parties should have the possibilities to find such secure and manageable solutions possibly together with telecommunication service providers in order to further develop a smart and secure grid operation.

In order to enable future functionality between the end user of the power system (this could be as a consumer or as a producer or both) and the power system (the grid operators) there will be various different solutions available such as smart metering, energy management systems in the home, industry and retail etc., broadband, satellite, radio, wireless. It is likely that fibre to the home will be widely prevalent in urban environments whereas rural environments will not be as attractive to commercial operators.

Currently there are two very different distinctive needs from the utilities perspective. The first is to manage the grid in a safe, secure and reliable manner in line with their license obligations. This has traditionally been achieved by using narrow bandwidth, low data volume, highly secure, highly resilient private communications infrastructure extended to areas where human habitation is sparse but power system infrastructure is needed. This is in contrast to the telcos business model of super high volumes, high bandwidth, best endeavours, with coverage where people are. There is a certain synergy in the 'last mile' delivery for communications that the utility does not yet cover.

The second need therefore is to understand the new services that may be required by their customers and who are allowed to deliver those when considering the different regulatory treatment in different Member States. If flexibility can be combined with other new services, e.g. broadband connectivity this could then facilitate further smart grids deployment. Is the market structure fit for purpose in these situations? Where do Member States have different communications and energy regulators who are responsible for this cross fertilisation of regulation? The detail of infrastructure sharing is yet to be detailed in many circumstances to this level. The EC and Member States will need to consider these implications for risk and reward to go hand in hand.

The recently adopted European Directive 2014/61 on "measures to reduce cost of deploying high-speed electronic communication networks" already enables telecoms and utilities to work together when upgrading their networks. NRAs or other designated bodies will also be in the position to issue binding dispute resolutions, if needed, where commercial negotiations between telcos and energy network companies on the use of infrastructure for the deployment of high-speed broadband networks fail. Additional innovative ways for utilities to efficiently deploy smart grids by making use of ICT solutions should be considered, and also pilots exploring innovative technological, operating and commercial arrangement at infrastructure level between telcos and utilities should be supported where deemed beneficial.

4.6. Interoperability (compatibility)

Firstly, interoperability is crucial to ensure that all data captured by smart meters and other sensors are readable and can be used efficiently by the market actors, irrespective of who collects the data or who bills the customer.

Secondly, aggregation service providers will rely on technologies that will be deployed by themselves, by new service technology providers or by manufacturers, such as white goods, heating, local intelligence, energy boxes, PV, electric vehicles, etc. in order to deliver flexibility. It is unlikely that a single communication standard would emerge in the near future. There is a clear need for products and systems compatibility for the home energy management since closed or proprietary solutions risk limiting customers in their choices and probably reduce features proposed.

Incentives that foster open systems, standards and protocols for demand response, as well as open devices and appliances using already available standards or standards in preparation could be deployed and would facilitate open and interoperable solutions for demand response.

Several levels of incentives could be considered:

- National initiatives (like Energy@home in Italy, AGORA in France) in order to accelerate market convergence on a common standard that can be open to different technical implementation on products.
- Through the promotion and usage of already available and coming standards that support interoperability.

5. Who should deliver the incentives?

5.1 At the EU level

The Energy Efficiency Directive where demand response is explicitly included has been adopted and the implementation will be monitored by the EC.

Smart grids projects already receive support from EU research and innovation activities, such as the Strategic Energy Technologies Plan, the European Electricity Grid Initiative, the 7th Framework Programme of Research as well as Horizon 2020 calls for proposals and projects of common European interest. The EU should further co-finance smart grid investments, moving toward deployment of smart grids across the EU.

Third parties may be also willing to provide incentives for the acquisition of specific solutions/products by end users. This possibility should be considered and enabled by removing any possible legal, fiscal or other barriers.

When implementing and revising the Target Model, the EU should ensure that flexibility is properly signalled and valued in the market.

5.2 At national level

Member States: The task of the Member States to integrate DR in the market is already foreseen in the EED. Laws regarding tariff regulation in gas and electricity as well as laws regarding gas and electricity prices and energy sales contracts might need amendments. A specific and binding time should be defined across Europe for all of the above.

NRAs: Once congestion management in distribution grids with the use of flexibility is made possible and larger volumes of DSF access the markets, the NRAs can play an important role of an intermediary, balancing the interests of the free market versus the level of societal cost, which for monopolies should be paid via regulated tariffs to accommodate traditional grid expansion but also investments in smart grids.

6. Good practices

Incentive barriers can depend on the national regulation regimes and market structures.

Innovation at grid operator level/smart grids

According to the specific circumstances, Member States and NRAs face different situations according to which they should act. The following could be considered:

- Sharing mechanisms for overspend or underspend: An efficiency incentive should be used to ensure that DSOs face strong financial incentives to control costs and implement approaches that provide good value for money for existing and future customers. The efficiency incentive can be used to share risk and benefit with consumers and stakeholders. Any overspends or underspend against the grid operators allowance will be shared with customers and stakeholders. This provides a strong incentive for DSOs to make efficiency gains on top of those set in the price control and will ensure that DSOs do not over invest to avoid interruptions and instead look for the most efficient solutions. This will drive grid operators to adopt flexible solutions including DSR in many cases.
- Removing R&D costs of grid operators from efficiency targets imposed by regulation, thereby encouraging grid operator to innovate.
- Regulatory incentives such as an innovation fund to support both small R&D and larger demonstration projects should be supported.

- Higher return on investments and a risk adjusted depreciation period for projects with significant investment and business risk.
- R&D expenditures are considered as "pass-through-costs" up to an adequate percentage of the revenues of the grid operators.
- Output based regulation: Incentives for grid operators can be described as input based or output based. Under an input based approach, the NRA calls for project proposals and selects the best of the proposals according to cost benefit analysis. It then allows the grid operator's remuneration through price control allowance or tariffs for the selected projects. Output based incentives are where the NRA sets upfront targets for the grid operators to meet (such as quality of service, or minimum technical requirements). The grid operator can then earn a financial reward if it beats these targets or penalties if it fails to meet them. One of the recommendations in the CEER smart grids conclusion paper is to introduce output based regulation. Such an approach can allow grid operator to weigh up the risks and rewards of new investments. For instance, deciding if they want to invest more in R&D to use the learning to beat outputs in the future and earn the financial rewards.
- Models for a fruitful co-operation between energy utilities and telecom operators already exist in several Member States.

Regulation to incentivise creation of new grid tariff systems:

- The creation of new grid tariff systems is the means by which the grid operator can offer the market actors more tools to deploy demand response.
- In some Member States it could be feasible for the customer if he is offered different tariff options. For instance flexible tariffs can take the form of a fixed tariff per time of use (like day/night distinction) or a dynamic tariff per time of use (like a higher tariff at times of congestion). Also the tariffs could be different for different loads (e.g. interruptible and non-interruptible). However, in some cases network tariffs and dynamic energy prices from the supplier or aggregator can work against each other, which should be avoided. New network tariff options such as more dynamic pricing schemes are being studied in Europe. Regardless of the tariff and pricing structures the coordination between market actors may be needed. While there will be times where tariffs and prices coincide, in some instances it may be difficult to avoid network tariff and dynamic energy prices working against each other. This issue needs further investigation and needs to be developed further in the future.
- Enabling long term price visibility for DR investors and customers, allowing bilateral agreements between them (e.g. long term contracts). Price stability and predictability is important to attract investors in an initial stage.
- Energy efficiency targets, measures and subsidies should also take into account flexibility opportunities and the needs of the energy system as a whole. The allocation of incentives/subsidies should be subject to a prior assessment taking into account energy efficiency performance as well as flexibility capabilities in order to take the most relevant measures towards an overall efficient system.

Additional good practices:

- Market premiums are interesting mechanisms for large-scale distributed generation in order to incentivize the participation in markets. It is a way to support the extra-costs that this participation would mean. We could find a best practice in the case of Germany.

7. Key Findings

1. Flexibility from both demand side and generation (independent of their size and connection point) has the potential to offer flexibility to the electricity and gas market. Assessment of technical and economic potential of demand side flexibility (DSF) across different customer groups and the factors preventing its realisation will determine what the needs for incentives are, taking into account the targets set and possible implications for competition.

2. Enhancing network monitoring and putting intelligence into the network will enable the integration of massive injection of DER. At the same time, the provision of grid services also by small-scale sources (demand and supply) to grid operators can help optimise the system. While smart grids and flexibility services-based solutions may increase operational costs, they are, in certain cases, more efficient than "putting copper and iron in the ground" in the long run. Customers are more incentivised to adopt smart solutions when they see a benefit for themselves and/or it helps them to avoid or reduce the costs they pay for connecting to the network. Grid operators thus need to consider both the traditional investment solutions (building up capacity) and the flexibility services-based solutions, or a combination of the two, depending on what is most efficient.

   However, grid operators need adequate incentives to pursue flexibility services-based solutions – identified barriers are:

   - If efficiency targets that they are subject to are difficult to achieve and if they are calculated on the basis of OPEX alone and/or if they offset extra remuneration of the asset base.
   - Demonstration projects and pilots are treated like any other costs, i.e. there is no specific compensation for the risks involved in testing new technologies and processes.
   - If they are not allowed (by legislation or regulation) to use flexibility service-based solutions.

   More measurements are required when flexibility products or options are offered to the customer. In most countries where a decision on smart metering roll-out has been made, DSOs are/will be responsible for the roll-out. As regulated entities DSOs have to be allowed to recover the corresponding cost for the roll-out and data handling through regulated revenues. Clear roll-out mandate and an appropriate regulatory framework is thus crucial.

3. Customers have very different profiles (in terms of income, geography, housing type, age, culture, attitude towards risks, level of consumption, etc.). At the same time, as grid users, they are becoming more complex and sophisticated agents who will play an increasing role in the system, both as recipient of energy services and as decentralised producers (prosumers).

   For further tapping customers flexibility potential, a reliable legal and institutional framework is needed. Dynamic pricing will allow retail prices to track changes in the wholesale prices, thus sending the relevant price signals on to customers. In addition, there is a need to investigate further how the regulated part of the bill call contributed to price signals for flexibility:

- First, in most European countries taxes and levies represent a significant and increasing part of electricity prices paid by end-customers, hampering the price signals sent to customers.
- Second, customers could be incentivised to actively adjust their consumption and/or generation patterns by flexible grid tariffs that are truly cost-reflective.

4. ICT and telecommunications are highly important for implementation of smart grids and for secure grid operation in general. Partnerships between utilities and telcos or use of existing or new telecommunication infrastructure could facilitate efficient deployment of the smart grid infrastructure, while respecting each party's roles and responsibility.

5. Smart appliances, smart home automation and more intelligent solutions will easily manage energy in the home in general and will minimize consumers' efforts in dealing with the opportunities offered by the future energy market. But replacement of existing appliances with the new smart products may take a long time, since consumers may not be willing to dispose of still perfectly working appliances simply because of the economic benefits offered by taking part to the energy markets.

6. Interoperability is crucial in order to accelerate market convergence on common standards that can be open to different technical implementation on products.

Chapter 4: Recommendations

Market Rules and Commercial Arrangements

RECOMMENDATION 1. ASSESS THE FLEXIBILITY POTENTIAL AND MAXIMISE THE VALUE OF FLEXIBILITY

Member States should assess, under the guidance of the European Commission, the overall Demand Side Flexibility (DSF) potential (realistic vs. theoretical), which DSF potential is already used and what upfront investments will be necessary to tap realistically achievable potential for different types of consumers (i.e. residential, commercial and industrial). A Cost Benefit Analysis, overall impact analysis and ambition setting are needed.

Based on such an assessment, **Member States and NRAs should ensure that the value of flexibility is maximised to the consumers and other providers of that flexibility, and continues to be maximised in an evolving market over time.** When developing new flexibility services for different types of customers, a careful assessment of costs and benefits related to different market design options should be undertaken.

RECOMMENDATION 2. EQUAL ACCESS TO ELECTRICITY MARKETS

Consumers shall be given the possibility to exploit the benefits of modifying their flexible consumption and injection. To ensure that the market is free from barriers and provides equal access for existing parties and new entrants, market rules (including the European Network Codes) should ensure that all service providers compete on a level playing field:

3.1. Market rules for intra-day, day-ahead and balancing and technical requirements should ensure a level playing field between supply side and flexible demand side resources, including prosumers. **Member States should adapt market rules so that the flexibility provided by demand side measures and all sizes of generation can compete on a level playing field with existing actors in these markets.**

3.2. Aggregators and suppliers should have the same ability to extract the value of flexibility services on behalf of their consumers. **Member States and NRAs should:**

- **Ensure that the participation of aggregated flexibility is legal, facilitated and enabled in all markets.**
- **Make sure that demand side flexibility is treated on an equal footing with generation on the basis of the volumes effectively delivered (whether in the form of electricity generated at customer site or demand variations).**
- **Ensure that essential technical requirements are fulfilled by the new service providers for a well-functioning market.**

RECOMMENDATION 3. CONTRACTUAL ARRANGEMENTS

Contractual arrangements should be simple, transparent and fair and allow consumers to access any service provider of their choosing, without previous permission of the BRP or supplier (although it may be necessary to protect consumers from multiple contracts for flexibility that conflict).

In the case of demand response being activated by a third party aggregation service provider, the BRP/Supplier should always be informed. Standard contracts should be put in place to ensure smooth contractual process, fair financial adjustment mechanism and standard communications procedures between aggregation service provider and the BRP/supplier. Where required, contracts, communication and money flows can be directed through an independent third party.

In the case of flexibility being valued through supply contracts, this does not apply.

Only when it is proved that existing means of metering would not be sufficient to measure flexibility provided by consumers, the aggregator should be allowed to provide the appropriate means of measuring that service. As regards data used for settlement purposes, that data needs to be certified by an independent third party, such as the TSO or DSO.

To protect consumers from unnecessary administrative and legal burdens, the aggregated pool of demand side resources should be treated as a single resource. Pre-qualification, verification should wherever possible be performed at this pooled level. For grid constraint management on the DSO level, local specifications will need to be taken into account.

European Commission and NRAs should collaborate in order to ensure that the regulatory framework enables the creation of these contractual arrangements.

RECOMMENDATION 4. FINANCIAL ADJUSTMENT MECHANISMS

Streamlined, simple payment arrangements between TSOs, DSOs, suppliers, BRPs, BSPs and aggregators are key to facilitate consumer participation.

This is particularly relevant in creating a financial adjustment mechanism between aggregators and BRPs/supplier in the case of a DR action being initiated by third party aggregators. The financial adjustment mechanism should enable competition, allowing for customer participation. This mechanism should ensure that all the electricity sourced on the market and consumed by end-customers is paid to the actor who sources it; and at the same time avoiding the BRP from having unfair costs incurred through the fulfilment of its balancing requirements.

The financial adjustment mechanisms should as much as possible be applicable and symmetric for both regulation-up (demand curtailment) and regulation-down (demand enhancement).

Two main principles should be respected when establishing financial adjustments mechanisms:

- The financial adjustment for the energy sourced should reflect the sourcing costs.
- The financial adjustment should ensure that benefits, risks and costs are directed to the party that causes them.

The European Commission should work with NRAs to develop relevant financial adjustment mechanisms facilitating further integration of the different EU energy markets and allow demand side flexibility to participate on a level playing field. Market rules should be holistic and developed in close cooperation with stakeholders, including aggregators, BRPs, consumers, suppliers and network operators.

RECOMMENDATION 5. DEFINITION OF BALANCE RESPONSIBILITY IN A CONNECTION

Keeping current role and responsibility of BRP intact is essential for well-functioning of electricity markets. Having a balance responsibility in a connection is crucial for maintaining system stability and security of supply. **Member States should ensure that the definition of balance responsibility in a connection is put in place**. That responsibility must be unambiguously defined in relation to all market parties that are supplying/receiving energy and/or invoking flexibility on that connection.

Gaps or overlaps in the balance responsibility of different actors on a connection must be avoided.

If a customer has contracts with more than one market actor on a connection, there needs to be separate settlement.

Certified metering data is necessary to allow the amounts to be allocated to the BRP and then settled in the settlement process if aggregated flexibilities want to participate in balancing markets.

As regards the interval for collection of metered values, a balance needs to be found between the need for accuracy and speed of the information on the one hand, and the related metering costs on the other.

Measurement of Flexibility

RECOMMENDATION 6. STANDARDISED MEASUREMENT METHODOLOGY FOR FLEXIBILITY

Where required, Member States should define a standardised measurement methodology for flexibility. The methodology should enable the allocation of the demand action of each service provider for a single connection. In order to enable cross border flexibility trade, there is in the longer perspective a need for harmonised EU wide principles and methodologies. This methodology should preferably be based upon smart metering data.

Consumers

RECOMMENDATION 7. TIMELY ACCESS TO DATA WHILE ENSURING CONSUMER PRIVACY

As access to data has significant potential to fuel market growth and market competition, the data manager should equally provide to all market parties – new and existing - sufficient, differentiated and timely data via appropriate market facilitation services.

To encourage energy service providers to offer contracts and services built around spot market prices, such as dynamic pricing and home and business automation controls, consumers should have the right to request and receive metering at a frequency corresponding to the national balancing settlement regime. Smart metering systems with a reading interval corresponding to the settlement time period are a technical prerequisite for participation in flexibility markets.

Accurate consumption information and accurate billing based on actual consumption are critical enablers of demand side flexibility, for domestic consumers in particular. Customers should maintain control of their data and always explicitly give their consent before their data is made available to third parties (to which the customer does not already have a contract). The customer has the right to withdraw his/her consent. The data access should be monitored and protected by Member States.

NRAs should ensure these possibilities are in place, as well as how costs are recovered. The five CEER guiding principles of data management should be observed (Privacy and security, transparency, accuracy, accessibility and non-discrimination.)

RECOMMENDATION 8. CLEAR FRAMEWORK FOR DOMESTIC CUSTOMERS

To achieve inclusivity and a positive domestic customer reception of demand side flexibility options, **industry and NRAs should work together especially on the introduction of aggregation services and dynamic pricing, taking into account the following:**

- Services and offers must be comprehensible.
- While recognising that customers can benefit from their ability to modify load through specific price offers, comparability in these offers must be supported.
- Identify feasible models for limiting the liability of customers when contracting with an aggregator or supplier.
- Ensure that information on flexibility services is simple and transparently provided to the customer.
- Enhance comparisons between services regarding flexibility by providing comparable key information without impeding competition and innovation.
- Consider the impact of demand side flexibility options on all domestic customers and especially vulnerable consumers, so that the benefits are shared appropriately and no one is adversely affected. Vulnerable customers may need additional protections.

NRAs and consumer protection agencies should seek innovative solutions to ensure consumer protections are adapted and not relaxed to accommodate demand side flexibility options.

Grid Operation

RECOMMENDATION 9. COMMUNICATION & COORDINATION FOR SECURE GRID OPERATION

DSOs and TSOs must have in place constraint management procedures in order to tackle constraints on their networks, including the right to require modification of flexibility activations in accordance with these procedures.

To ensure safe, secure and cost-efficient distribution and transmission network operation and development, both the DSOs and TSOs must have access to flexibility services and all technical relevant data needed to perform their activities both at pre-qualification stage and in real time (or close to real time).

DSOs and TSOs shall exchange relevant operational data with each other. When congestion areas occur, DSOs and TSOs will make the appropriate information available to all concerned parties (BRP, aggregators, suppliers etc.).

Relevant activation of flexibility – or its modification - by DSOs or TSOs shall be exchanged with each other in advance, before the selection of the flexibility to be activated. Regulated revenues should allow the recovery of these costs in a way that does not distort the optimal economical arbitrage for the system between distribution and transmission system grid reinforcement/development versus costs of managing grid congestions without this grid extension.

The European Commission should work together with NRAs, DSOs, TSOs suppliers and aggregators on the above issues and identify necessary actions.

Incentives

RECOMMENDATION 10. OPEN AND INTEROPERABLE STANDARDS FOR INTERFACES

Devices on the customer premises (e.g. smart appliances, in home displays) may need to have the ability to communicate with the smart meters. The smart metering systems should be equipped with a gateway or interface to the home, which would support energy management systems and home automation. Therefore, to enable demand response, **Member States should ensure that internationally accepted open and interoperable standards for interfaces are in place**. While developing these, the legal/regulatory framework should keep as many options as possible open for the consumer, recognising that the development of aggregation services will trigger technology and marketing innovation.

Member States should incentivise the use of these standards through national initiatives as well as promotion of already available and coming standards. Such incentives should foster open systems, open standard, open protocols for demand response, as well as open devices and appliances.

RECOMMENDATION 11. SECURE COMMUNICATION INFRASTRUCTURE AND SERVICES & UTILITY-TELCO SYNERGIES

Commission, Member States and NRAs should encourage TSOs, DSOs, telecommunication companies and ICT companies to identify a favourable business, regulatory and technological environment for the cost-effective deployment of secure and manageable communication infrastructures and services for Smart Grids which support the further development of flexibility.

The process of conclusion of commercial agreements by TSOs, DSOs and telecommunication operators should, where necessary, be facilitated, in view of possible efficiency gains for both sectors. Member States and NRAs should support synergies between smart grid and broadband deployment while ensuring a secure and stable energy grid operation (electricity and gas) and respecting each party's roles and responsibilities.

RECOMMENDATION 12. INCENTIVISE GRID OPERATORS TO ENABLE AND USE FLEXIBILITY

In order to cope with increasing investment needs in network infrastructure, **NRAs and Member States should incentivise grid operators to make efficient long-term investments that will support the EU's Energy and Climate targets for 2030 rather than focus on short-term optimisation.** This would reduce the risk of stranded assets at the expense of the generality of distribution network customers. Measures for achieving this should include:

- Member States and NRAs should ensure that grid operators are given the tools for optimising investment in networks through the use of flexibility and smart grids solutions. Member States and NRAs should remove regulatory provisions that prevent grid operators from having the option to contract flexibility, while maintaining their position as neutral market facilitators, where applicable. Cost recovery should be assured by NRAs when grid operators are purchasing flexibility for grid services in an efficient way.
- Innovative investments (such as smart metering roll out) should be treated adequately and their costs should be recovered on time. Regulation should be technology neutral and incentives for OPEX should be treated, similarly to incentives for CAPEX. Costs of demonstration and pilot projects should not be treated as costs under an efficiency incentive but under dedicated innovation/demonstration and pilot projects incentive.
- National regulatory authorities should define, on the basis of a wide stakeholders' consultation, transparent, fair and clear boundary conditions for the market-based, where possible, provision of flexibility services.
- Schemes allowing connecting grid customers to reduce their costs through adopting smart technologies (such as variable network access offered as a discounted connection) should be developed.
- The European Commission should consider the further funding of smart grid projects which should not be limited to any voltage level.
- Coordination between national and EU funding should be enhanced to make best use of the available financing possibilities.

RECOMMENDATION 13. IMPROVE PRICE SIGNALS TO INCENTIVISE CONSUMERS' RESPONSE

NRAs and Member States should work towards creating a favourable business, regulatory and technological environment designing policies and measures tailored to the different groups of customers to effectively enhance their participation and engagement and to ensure value for money for consumers in the prioritization of investments to be undertaken via:

- Progressively phasing out **regulated prices** for all customers.
- Enabling **innovative grid tariff structures** that incentivise network customers for delivering the needed flexibility to the system, (e.g. through time of use tariff schemes, more power/capacity based tariffs or different contractual options). Distribution network tariffs should be allowed to be cost-reflective and have a transparent allocation of network costs, with appropriate information, gradual transition and protections where necessary.
- Assessing the **impact of increasing taxes and levies** within the end-user electricity prices on customers' flexibility and better linking wholesale and retail energy prices that would allow providing better price signals for flexibility to customers.
- Facilitating self-consumption through efficient economic signals and incentives.
- Measures tailored to the different groups of consumers to **effectively enhance their participation**, such as facilitating frameworks for self-consumption, dedicated policies to help consumers control their energy costs and new types of contracts between consumers and suppliers and third party services. Specific benchmarks should be developed to assess ex post the efficiency of policies and ensure that concrete benefits are delivered to final consumers.

A full assessment of the impact of the different policy alternatives on the respective consumer segments is required, including vulnerable consumers and residential customers for whom the benefits of flexibility will only become possible in the later stages of the development of markets with flexibility. Existing social and environment protections (including energy affordability), and fair and inclusive treatment of all customers should be safeguarded.

RECOMMENDATION 14. SMART APPLIANCES FOR END USERS

As enablers of active demand side participation at residential level, smart appliances could potentially receive incentives in the early stages of their development. Such incentives would aim to reduce the initial acquisition cost to end users in order to speed up the uptake of smart appliances and encourage residential consumer participation in the electricity market. However, the case would have to be made that this expense would deliver a clear benefit to all consumers.

ANNEX 1. List of Participants

Organisation	Name of Expert
BEREC	Maarten de Klijn, ACM (Netherlands) Soeren Nuebel, BNETZA (Germany)
CECED	Marco Signa, Whirlpool (Italy) Candice Richaud, CECED (Belgium)
CEDEC	Falk Engelmann - VKU (Germany) Paul De Wit - Alliander (Netherlands)
Consumer Futures	Heidi Ranscombe
DIGITAL EUROPE	Hamid Amir-Alikhani, Panasonic (Germany) Klaus-Dieter Axt, DigitalEurope, Director
EASE	Maria João Duarte, Policy Officer, European Association for Storage of Energy
ECOS	Dania Cristofaro Thomas Willson
EDSO	Olivier Chatillon from ERDF Florian Chapalain, EDSO secretariat
EPIA	Alexandre Roesch, EPIA (Belgium) Giorgia Concas, EPIA (Belgium)
ENTSO-E	Two members and one alternate: Susana Bañares Hernandez (REE, Spain) Jesús Mendiola Wippermann (REE, Spain) Thong Vu Van (ENTSO-E)
ETNO	Lorenzo Pupillo, Telecom Italia Rainer Koch, DEUTSCHE TELEKOM AG Francesco Versace (alternate)
EURELECTRIC	From the DSO side (one member and alternate): - Marcus Merkel (EWE NETZ) (Germany) - Joao MARTINS DE CARVALHO (EdP) (Portugal) From the retail customer side (one member and alternate): - Jean-Paul Krivine (EdF) (France) - Marion LABATUT, EURELECTRIC (Belgium)
EUROGAS	Noel Regan, Eurogas (Belgium) Margot Loudon, Eurogas (Belgium)
EUTC	Miguel Angel Sánchez Fornié (Spain) Duncan Botting (UK)
ESMIG	John Harris Thomas Weisshaupt
GEODE	Carmen Gimeno, GEODE Hans Taus, Wiener Netze GmbH (Austria)
GSMA	Svetlana Grant, GSMA
ORGALIME	Patrick BERNARD, Schneider Electric (France) Ulrich FIKAR, Orgalime aisbl (Belgium)
RAP	Phil Baker Mike Hogan
SEDC	Jessica Stromback Yannick Phulpin, EDF Research
T&D	Two members and one alternate: Guillermo Amann, Ormazabal (Spain) Renzo Coccioni, Schneider Electric (France) Prof. Jochen Kreusel, ABB (Germany)

ANNEX 2. Editorial Team

Organisation	Name
European Commission DG ENER DG CNECT	Manuel Sánchez-Jiménez Konstantinos Stamatis Michaela Kollau Mariana Stantcheva Erika Busechian
CEDEC	Peter Hermans, Stedin (NL)
CEER	Dora Guzeleva, Ofgem (UK) Gunilla Eng Abrandt, ei (SE) Werner Friedl, E-Control (AT)
EURELECTRIC	Pavla Mandatova
SEDC	Jessica Stromback

ANNEX 3. Definition of key terms relating to flexibility

Aggregator
A legal entity that aggregates the load or generation of various demand and/or generation/production units. Aggregation can be a function that can be met by existing market actors, or can be carried out by a separate actor. EED: aggregator' means a demand service provider that combines multiple short-duration consumer loads for sale or auction in organised energy markets.

Ancillary Service
All services necessary for the operation of transmission system and distribution networks (including LNG facilities, and/or storage facilities for gas, these services include load balancing, blending and injection of inert gases and do not include facilities reserved exclusively for transmission system operators carrying out their functions.

Balancing Market/Trading Platform
(Electricity) Balancing Market means the entirety of institutional, commercial and operational arrangements that establish market-based management of the function of Balancing within the framework of the European Network Codes.
(Gas) a trading platform where a transmission system operator is a trading participant to all trades.

Balancing Portfolio
Grouping of a network user's inputs and off-takes in a portfolio. The imbalances of the portfolio will be billed to the Balancing Responsible Party. Every consumption or injection has to be administered in a portfolio.

Balance Responsible Party
A market- related entity or its chosen representative responsible for its imbalances.

Balancing Services
A service provided to a transmission system operator from a BSP.

Balancing Service Provider
Balancing Service Provider means a Market Participant providing Balancing Services to a TSO.

Biomethane
Any gas fuel derived from the decay of organic matter, as the mixture of methane and carbon dioxide produced by the bacterial decomposition of sewage, manure, garbage, or plant crops.

Black Start
(Electricity) The recovery of a Power Generating Module from a total shutdown through a dedicated auxiliary power source without any electrical energy supply which is external to the Power Generating Facility.

Constraints/Congestion Management
(Electricity) Set of actions that the network operator performs to avoid or relieve a deviation of the electrical parameters from the limits that define the secure operation. This term includes congestion management and voltage control.
(Gas) The management of the capacity portfolio of the transmission system operator with a view to optimal and maximum use of the technical capacity and the timely detection of future congestion and saturation points.

Curtailment at End User
The reduction of the gas/electricity flow at the connection to an end user. Can go down to zero.

Customer
A wholesale or final customer of electricity; (Third package, Electricity Dir. Consumer is not defined, but both terms are used in the Dir.)

Demand Side Flexibility
The changes in energy usage by end-use customers (domestic and industrial) from their current/normal 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 organized electricity markets.

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

Demand Side Response
Voluntary changes by end-consumers or producers or at storages of their usual electricity/gas flow patterns - in response to market signals such as time-variable prices or incentive payments.

Demand Reduction
The voluntary or involuntary reduction in electricity demand by end –consumers.

Demand Side Participant
An actor who actively participates in a demand side action either directly, through facilitation, or through receiving the benefits of that demand side action.

Distributed Generation/Gas Production
'Distributed generation' means generation plants connected to the distribution system; Gas production refers to natural gas wells, Biomethane or Power-to-Gas plants connected to the distribution system.

Distribution System Operator
(Electricity) The natural or legal person responsible for operating, ensuring the maintenance of and, if necessary, developing the distribution system in a given area and, where applicable, its interconnections with other systems and for ensuring the long-term ability of the system to meet reasonable demands for the distribution of electricity; Moreover, the

DSO is responsible for regional grid access and grid stability, integration of renewables at the distribution level and regional load balancing.
(Gas) A natural or legal person who carries out the function of distribution and is responsible for operating, ensuring the maintenance of, and, if necessary, developing the distribution system in a given area and, where applicable, its interconnections with other systems, and for ensuring the long-term ability of the system to meet reasonable demands for the distribution of gas.

Distributional impact assessment (DIA)
An analysis of a proposed project or policy that evaluates its relative effects on different social groups. For example this could be groups differentiated by income, age or habits.

Energy Efficiency
An actual reduction in the overall energy used, not just a shift from peak periods. Energy efficiency is a way of managing and restraining the growth in energy consumption. Something is more energy efficient if it delivers more services for the same energy input, or the same services for less energy input.

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

Energy service provider
A natural or legal person who delivers energy services or other energy efficiency improvement measures in a final customer's facility or premises; (from EED)

Energy Storage
Can broadly be considered as an activity to take energy whenever and in whatever form it is available, store it in whatever form is best (with our without conversion) and then put this energy back into the system in whatever form is best (with or without reconversion) for use at the time one needs it.

Final customer
A natural or legal person who purchases energy for own end use (from EED).

Frequency Control
(Electricity) Frequency Control - is the capability of a Power Generating Module to control speed by adjusting the Active Power Output in order to maintain stable system Frequency (also acceptable as speed control for Synchronous Power Generating Modules).

Frequency Containment Process
A process that aims at stabilizing the System Frequency by compensating imbalances by means of appropriate reserves.

Generator/producer
A natural or legal person generating electricity or producing gas; Generating electricity, contributing actively to voltage and reactive power control, required to provide the relevant data (information on outages, forecast, and actual production) to the energy marketplace.

ICT
Information and communications technology.

Imbalance Settlement
A financial settlement mechanism aiming at charging or paying Balance Responsible Parties for their imbalances.

Line pack
The storage of gas by compression in gas transmission and distribution systems, but not including facilities reserved for transmission system operators carrying out their functions.

Load Profile
The estimated variation of electrical/gas load versus time. A load profile will vary according to customer type e.g. residential, commercial and industrial and/or temperatures and/or week-days. Load profiles are used to convert the monthly/yearly metered consumption data into estimates of daily/hourly or quarter hourly consumption.

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

Portfolio Balancing/Allocation
(Electricity) An allocated Volume means an energy volume measured or estimated to be injected or withdrawn from the system and attributed to a Balance Responsible Party, for the calculation of the Imbalance of that Balance Responsible Party.
(Gas) The quantity of gas attributed to a network user by a transmission system operator as an input or an off-take expressed in kWh for the purpose of determining the imbalance quantity in a settlement period. According to the NC BG the settlement period will be the gas day.

Post Fault Management/Emergency Restoration
Post Fault Management means any kind of measures applied by a Network Operator to return to the acceptable operating boundaries of the grid, in terms of thermal/voltage/short-circuit/frequency and Dynamic Stability limits.

Price
A schedule of prices for the sale of energy by a supplier or other commercial market participant.

Primary Control Power/ Frequency Containment Reserves
Frequency Containment Reserves mean the operating reserves necessary for constant containment of frequency deviations (fluctuations) from nominal value in order to constantly maintain the power balance in the whole synchronously interconnected system. Activation of these reserves results in a restored power balance at a frequency deviating from nominal value. This category typically includes operating reserves with the activation

time up to 30 seconds. Operating reserves of this category are usually activated automatically and locally.

Prosumer
A consumer who produces electricity.

Reconciliation
Reconciliation accounts for the differences between the attributed quantity of electricity/gas into the balancing portfolio with a load profile and the metered quantity of electricity/gas at the end-user. Reconciliation will be billed from the TSO or DSO to the BRO or supplier and is usually relevant only for load profile customers.

Secondary Control Power / Frequency Restoration Reserves
The operating reserves used to restore frequency to the nominal value and power balance to the scheduled value after sudden system imbalance occurrence. This category includes operating reserves with an activation time typically up to 15 minutes (depending on the specific requirements of the synchronous area). Operating reserves of this category are typically activated centrally and can be activated automatically or manually. In these Framework Guidelines, automatically activated reserves refer to reserves activated by an automatic controller.

Self-generation
Power generation at the premises of a consumer, which may reduce the net load. Dispatchable self-generation can be used as back-up power.

Supplier
Any natural or legal person who carries out the function of supply; has a contractual agreement with end customer relating to the supply of electricity/gas.

Supply
(Electricity) The sale, including resale, of electricity to customers.
(Gas) The sale, including resale, of natural gas, including LNG, to customers.

Synthetic Natural Gas
Gas that can be produced from fossil fuels such as lignite coal or from biofuels, when it is named Bio-SNG or from electrical energy through electrolysis of water to create hydrogen which is then reacted with CO2 in the Sabatier reaction.

System Balancing
(Electricity) All actions and processes, on all timelines, through which TSOs ensure, in a continuous way, to maintain the system frequency within a predefined stability and to comply with the amount of reserves needed per Frequency Containment Process, Frequency Restoration Process and Reserve Replacement Process.
(Gas) An action undertaken by the transmission system operator to change the gas flows onto or off the transmission network, excluding those actions related to gas unaccounted for as off-taken from the system, and gas used by the transmission system operator for the operation of the system.

Tariff/Grid Tariff
A schedule of prices for the usage of the grid.

Telco
Telecommunication company - provides telecommunications services such as telephony and data communications.

Tertiary Control Power/ Replacement Reserves
Operating reserves used to restore the required level of operating reserves to be prepared for a further system imbalance. This category includes operating reserves with activation time from 15 minutes up to hours.

Trading Platform (gas)
An electronic platform provided and operated by a trading platform operator by means of which trading participants may post and accept, including the right to revise and withdraw, bids and offers for gas required to meet short term fluctuations in gas demand or supply, in accordance with the terms and conditions applicable on the trading platform and at which the transmission system operator trades for the purpose of undertaking balancing actions;

Transmission System Operator
(Electricity) A natural or legal person responsible for operating, ensuring the maintenance of, and if necessary, developing the transmission system in a given area and, where applicable, its interconnections with other systems, and for ensuring the long-term ability of the system to meet reasonable demands for the transmission of electricity. Moreover, the TSO is responsible for connection of all grid users at the transmission level and connection of the DSOs within the TSO control area.
(Gas) A natural or legal person who carries out the function of transmission and is responsible for operating, ensuring the maintenance of, and, if necessary, developing the transmission system in a given area and, where applicable, its interconnections with other systems, and for ensuring the long-term ability of the system to meet reasonable demands for the transport of gas.

Users of flexibility
All users of the electricity system who offer and require flexibility services;

Users of the system / system user
A natural or legal person supplying to, or being supplied by, a transmission or distribution system[26].

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

Voltage Control
A distribution system control managed by distribution system operators in order to maintain voltage in their networks within limits and to minimise the reactive power flows and consequently, technical losses and to maximise available active power flow.

[26] European Commission Directive 2009/72/EC

ANNEX 4: Flexibility services (products and markets)

The objective of the matrix below is to assist in defining possible future arrangements (and not to describe current arrangements) and in identifying potential barriers, in addition to transitional arrangements that will make the market effective. The matrix provides a list of users, services and providers of flexibility. It does not attempt to provide a comprehensive list but rather constitutes a starting point for an analysis of future arrangements.

It should be noted that the matrix below does not map the many relationships between users/buyers and providers/sellers of flexibility services. The matrix has been used as a tool to extract these relationships throughout Chapter 2.

Table 1: Flexibility Services Matrix

ser / buyer f flexibility	Required flexibility Services
alancing esponsible arty	Portfolio Optimization[27] (E&G)[28] Adjusting production. (E&G) Adjusting demand Increase or decrease demand (E&G) Trading forward market, day ahead market, intraday market and balancing market.
ansmission ystem perator	Transmission System Operation (E)[29] Frequency control Frequency Control Reserves, Frequency Restoration Reserves, Replacement Reserves [30] (G[31]) System balancing (E&G) Congestion management

Providers / sellers of flexibility	Products which can be provided
Large generators	(E) Primary, secondary, and tertiary balancing services
Large industrial / commercial customers	(E&G) Peak shifting and demand adjustments (E) Secondary and tertiary balancing services?
(Aggregated) small industrial and commercial users/ domestic customers	(E&G) Peak shifting (E&G) Demand adjustments (manually / automatic) (E) Secondary / tertiary balancing services (E) Small scale generation (EV) (E&G) curtailment

	(E) Grid losses compensation	(Aggregated) distributed generation	(E) Generation adjustments (CHP) (E) Secondary or tertiary balancing services (CHP, back-up generator). (G) Biogas injections (E&G) Congestion management services (long term and short term including curtailment) (E) Reactive power?
istribution ystem perator	Active distribution management (E) Long and short term congestion management (to avoid/defer grid reinforcement) (E) Voltage control / reactive power management (E&G) Grid losses compensation		

Users / buyers and requirements of flexibility services

Table 2 Timetable of flexibility operation for a BRP

Possible action	Month / Week before	Day before	During the day	Hourly	15 / 30 minute
Production	Plant production and maintenance schedules	Wind and sun predictions can change the utilisation of the production units.	Schedule adjustments based on wind, sun and the utilization of the generation units.	Relatively fast reaction generation units can be used for hourly adjustments.	Only the fast reaction generation units can be used.
Demand	Production schedules of large customers can be taken into account.	Whether forecast and production schedules of large customers are taken into account	The actual weather and the actual consumption of large customers are monitored.	Real time weather and large connections monitoring	The system balance is monitored
Trading	Future & Forward market	Day ahead spot market	Intra-day market	Intra-day market	Balancing market (TSO as counter

					party)

Transmission system operator:

Because all TSO control areas within the ENTSO-E area are interconnected, disturbances affect system performance of the pan-European power system. For this reason pan-European policy specifies a system of control reserves and common technical boundary criteria to which individual national implementations must adhere. TSO's are responsible for the system's power balance by maintaining and activating primary, secondary and tertiary control reserves in response to disturbances. These reserves are called in sequence.

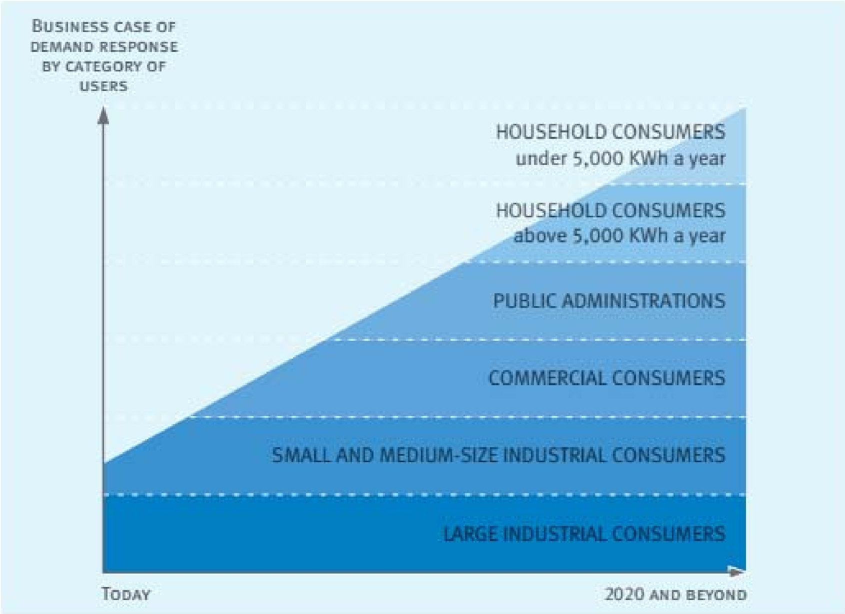
Table 3 Activation of primary, secondary and tertiary control reserves

Control Reserve		Activation	Reaction speed	Accessibility	Block size
Primary	Automatically activated. It is usually compulsory.	Activated on frequency deviation (± 20 MHz)	15 sec. 50% 30 sec. 100%	Tenders / obligation	in MW
Secondary	The aim of the reserve is to reconstitute the primary reserve when it has been used.	Signal In most cases automatically activated.	Reaction in minutes Typically 5 min or x% per min.	Tenders / market (bid ladder)	in MW or MWh
Tertiary	Complementary reserve and is often the core of the balancing market. It is usually manually activated and split into rapid reserve (10-15 minutes) and cold reserve.	EDI message or telephone call.	Within 15 minutes		in MW or MWh

Providers and service description of offered flexibility services

Many large and energy intensive industrial consumers already use demand response services, and further services will develop over time. We expect the market to develop according to the figure below.

Figure 1 Development of demand response market



Household electricity consumption and customer preferences differ significantly across Europe, hence the potential for demand response at the household level will also differ. In countries such as Sweden and Finland for instance, the average yearly household consumption is three times higher than in Southern Europe (around 15,000 kWh compared to less than 5,000 kWh).

ANNEX 5. Baseline

Baselines should balance accuracy, simplicity and integrity. They should be designed to produce statistically valid and consistent results, unbiased in either over-predicting or under-predicting actual performance. There are numerous reliable methodologies and ICT solutions that are able to establish reliable baseline values, currently in use throughout the world, and it is not necessary to re-invent the wheel when implementing demand side flexibility into a market design.

A baseline is important to calculate the effective service provided by the aggregation service provider and to avoid strategic users from being incentivized to emphasize their individual benefits without real gain for the system. The baseline must make it possible to differentiate services performed behind the same point of delivery, making it possible to differentiate between the benefits of for example dynamic pricing and specific demand side flexibility services valued by an aggregation service provider.

ANNEX 6: Country cases for Research Development & Demonstration in the grid

Country cases:

- **Finland:** The R&D compensation is less than €2 million for the biggest DSO. The handling of asset values has a much bigger impact. Regulatory asset values for the new components are based on negotiations with the regulator. When more new components are installed, the 'first-mover' thus faces a significant risk that the asset value will decrease dramatically when the cost catalogue is updated.

- **France**: A new instrument including a dedicated amount for R&D and pilots was issued at the end of 2013. If the DSO spends less than the allowed amount, this amount is returned to the tariff. Spending above the forecasted amount is at the company's risk.

- **Germany**: There are many instruments in place to support R&D. Pilots and R&D projects often funded by the federal or local governments. In 2013 the federal government spend about €809 million to support energy related R&D projects (€31 million specifically for the grid area). Main focus is the integration of DER. Within the German incentive regulation costs for R&D are handled same way like other costs (that means they are checked for efficiency and if they fulfil all requirements they are approved by the regulator). Besides this there is a new rule since August 2013 (§ 25a ARegV) enacted, that allows grid operators to increase their revenue cap to fund specific publicly supported R&D projects or pilots.

- **Portugal**: There is an incentive of an extra 1.5% remuneration on the asset base of innovative projects. This only applies to small R&D/pilot projects and excludes any mass deployment of innovative technology. Furthermore, it requires extra cost-efficiency that more than offsets the extra remuneration of the asset base.

- **Italy:** Eight pilot projects have been selected by the regulator. These projects have been given approval for 2% extra WACC for 12 years.

- **Norway:** Since 2013, regulation allows for passing through of RD&D costs to a certain degree. The projects shall be aimed at contributing to an efficient operation, utilisation or development of the electricity network, recommended by the Research Council or similar institution.

- **The UK:** As part of the electricity distribution price control that runs from April 2010 until March 2015, the regulator established the Low Carbon Networks (LCN) Fund. The LCN Fund allows up to £500m to support projects sponsored by the DSOs to try out new technology, operating and commercial arrangements. DSOs are then required to show that they are using the outputs from these trials in their business plans.

ANNEX 7: Country cases for Smart grids and smart metering as enablers of flexibility

Country cases - smart metering:

- **Norway:** Smart meter investments are mandatory for all customers (to be completed by 2019). The investment period is equal for all DSOs and network company costs shall increase at roughly same speed. As a result of yardstick regulation, cost would then be covered. The DSO with the highest efficiency score will have the highest rate of return.

- **France:** the NRA has introduced a specific regulatory framework for the Linky project in order to incentivize the DSO to comply with the objectives initially set out (i.e. deploying 35 millions of smart meters by 2021 for €5 bn approx.). In particular, the DSO will be regularly assessed on: investment costs control: the DSO get a malus if the effective cost per unit is higher than the reference cost; on the contrary, it will earn the same amount if it achieves a decreasing of costs timeliness of deployment: the DSO will receive a financial penalty per meter that hasn't been deployed or doesn't function properly; the level of the penalty changes along with the different steps of the project.

- **Germany:** New function introduced to the role of default meter operator 'DSO as default meter operator, responsible for Smart Meter Gateway Administration (SMGW-A); Rollout likely to have a quote of 100%, BUT separated by technique: intelligent Meter (iZ) for customer under 6.000 kWh/a, intelligent Measuring Systems (iMsys) for all customer about 6.000 kWh/a.; Finance mechanism - still in progress; Renewable generator obligatory installation of iMsys (starting from 0,25 kW); approx. 50 Mio. iZ/iMsys electricity & 14 Mio Gas by 2029; Cost of the Rollout during the Rollout (approx. 2016-2032): ca. 10 billion EUR.

Document reference list

[ADDRESS-1] ADDRESS Project, Active Distribution network with full integration of Demand and distributed energy RESourceS, available at http://www.addressfp7.org/

[ADDRESS-2] ADDRESS, "The ADDRESS Project: Developing Active Demand in Smart Power Systems integrating Renewables", Régine Belhomme, Ramon Cerero, Giovanni Valtorta and Philippe Eyrolles, IEEE General Meeting, Detroit, USA, July 2011, http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=6038975&tag=1

[BNetzA] Bundesnetzagentur (German regulator): "Smart Grid" und "Smart Markets" Eckpunktepapier der Bundesnetzagentur zu den sich ändernden Aspekten des Energieversorgungssystems ("Smart Grid" and "Smart Markets" White paper of Bundesnetzagentur regarding the changing aspects of the energy supply system), available in German Bonn, 2012. http://www.bundesnetzagentur.de/SharedDocs/Downloads/DE/Sachgebiete/Energie/Unternehmen_Institutionen/NetzzugangUndMesswesen/SmartGridEckpunktepapier/SmartGridPapierpdf.pdf?__blob=publicationFile&v=2
Summary in English at:
http://www.bundesnetzagentur.de/SharedDocs/Downloads/DE/Sachgebiete/Energie/Unternehmen_Institutionen/NetzzugangUndMesswesen/SmartGridEckpunktepapier/SmartGridPapier_EN.pdf?__blob=publicationFile&v=3

[CEER 13] CEER, public consultation document, Regulatory and Market Aspects of Demand-Side Flexibility, November 2013. Avaailable at: http://www.ceer.eu/portal/page/portal/EER_HOME/EER_WORKSHOP/CEER-ERGEG%20EVENTS/Electricity/Demand-Side-Flexibility-2013/Tab

[CE Delft] *Societal cost base analysis of smart grids; January 2012 (Summary in English 8* pages, Dutch report 144 pages). HTTP://WWW.CE.NL/?GO=HOME.DOWNLOADPUB&ID=1236&FILE=CE_DELFT_3435_SUMMARY_SOCIAL_COSTS_AND_BENEFITS_OF_SMART_GRIDS_1337175039.PDF

[CENCENELEC/ETSI] Draft report M490 wg Methodology, annex B, December 2013 http://ec.europa.eu/energy/gas_electricity/smartgrids/doc/xpert_group3_methodology.pdf

[CEN-CENELEC-ETSI] Smart Grid Coordination Group First Set of Standards report (link).

http://ec.europa.eu/energy/gas_electricity/smartgrids/doc/xpert_group1_first_set_of_standards.pdf

[CLNR] CNLR: Customer-Led Network Revolution http://www.networkrevolution.co.uk/industryzone/projectlibrary/learning-outcome-2-results

[DECC/Ofgem] The Transform Model (DECC/Ofgem): The Smart Grid Forum's Work Stream Six: https://www.ofgem.gov.uk/electricity/distribution-networks/forums-seminars-and-working-groups/decc-ofgem-smart-grid-forum/work-stream-six

[ECORYS/ECN] "The role of DSO's in a smart grid environment" Rotterdam/Amsterdam, April 2014 (to be published)

[E-ENERGY] R&D Project E-Energy, http://www.e-energy.de/en/

[ENA/ENERGY UK] ENA/Energy UK, Smart Demand Response: A Discussion Paper, July 2012 Link: ENA/Energy UK, Smart Demand Response

[ENTSO-E draft] Network Codes] on RfG, LFCR, OS, EB, as well as their "Survey on Ancillary Services Procurement & Balancing Market Design": http://networkcodes.entsoe.eu/ https://www.entsoe.eu/major-projects/network-code-development/ https://www.entsoe.eu/fileadmin/user_upload/_library/resources/BAL/121022_Survey_on_AS_Procurement_and_EBM_design.pdf .

[EU] Taskforce smart grids Expert group3: EG3 First Year Report: Options on handling Smart Grids Data, January 2013, Brussels, 2011 http://ec.europa.eu/energy/gas_electricity/smartgrids/doc/xpert_group3_first_year_report.pdf

[EU] COM (2013) 7243 Communication "Delivering the internal electricity market and making the most of public intervention"

http://ec.europa.eu/energy/gas_electricity/doc/com_2013_public_intervention_en.pdf

[EU] SWD(2013) 442 final "Incorporating demand side flexibility, in particular demand response, in electricity markets"

http://ec.europa.eu/energy/gas_electricity/doc/com_2013_public_intervention_swd07_en.pdf

[EU] COM (2014) Retail Energy Market Background Document to Public Consultation (link)

[EURELECTRIC] EURELECTRIC Active Distribution System Management: A Key Tool for the Smooth Integration of Distributed Generation, Brussels, 2013. Link: Active Distribution System Management Full Report
Link: Active Distribution System Management, Recommendations

[EURELECTRIC] EURELECTRIC Network Tariffs for the Smart Energy System, Brussels, 2013. Link: Network Tariffs for the Smart Energy System

[EURELECTRIC] EURELECTRIC Retail Revolution – Power to the Customer, Brussels, 2013. Link: Retail revolution

[EURELECTRIC] EURELECTRIC Views on Demand-Side Participation, Brussels, 2011 http://www.eurelectric.org/media/61240/dsp_report_0810-02_simple_page_final-2011-030-0638-01-e.pdf

[EURELECTRIC] EURELECTRIC Flexibility and Aggregation, http://www2.eurelectric.org, Brussels, January 2014. http://www.eurelectric.org/media/115877/tf_bal-agr_report_final_je_as-2014-030-0026-01-e.pdf

[EURELECTRIC] EURELECTRIC The role of DSOs on Smart Grids and Energy Efficiency, Brussels, January 2012 Link: Role of the DSO

[EURELECTRIC] EURELECTRIC Flexible Generation: Backing up Renewables, Brussels, October 2011 Link: Flexibility Generation

[FINSENY] FINSENY Project, Future INternet for Smart ENergY, http://www.fi-ppp-finseny.eu/deliverables/

[Fraunhofer ISI and Forschungsgesellschaft für Energiewirtschaft] Load Management as a Way of Covering Peak Demand in Southern Germany" – Summary of intermediate findings from a study conducted by Fraunhofer ISI and Forschungsgesellschaft für Energiewirtschaft. http://www.agora-energiewende.org/fileadmin/downloads/publikationen/Studien/Lastmanagementstudie/Agora_Study_Load_Management_as_a_Way_of_Covering_Peak_Demand_in_Southern_Germany_Summary_of_Intermediate_Findings_web.pdf

[HEM-RM 2011] The Harmonized Electricity Market Role Model (December 2011), ENTSO-E, online: https://www.entsoe.eu/fileadmin/user_upload/edi/library/role/role-model-v2011-01.pdf.

[MIRABEL] MIRABEL, Micro-Request-Based Aggregation, Forecasting and Scheduling of Energy Demand, Supply and Distribution

[OSGP] the Open Smart Grid Protocol (OSGP) for Grid Technologies (http://www.osgp.org/ and http://www.etsi.org/index.php/news-events/news/382-news-release-18-january-2012

[ORGALIME] Electra II - 'The Smart World' Published: 24 April, 2012, (link) http://www.orgalime.org/position/electra-ii-smart-world

[ORGALIME] Orgalime response to the CEER Public Consultation on Regulatory and Market Aspects of Demand-Side Flexibility http://ec.europa.eu/energy/gas_electricity/smartgrids/doc/xpert_group3_ceer.pdf

[Orkney Storage Park (Phase 2)]: http://www.energynetworks.org/electricity/smart-grid-portal/lcnf/tier-1/scottish-and-southern-energy-power-distribution/orkney-energy-storage-park-(phase-2).html

[RESERVICES-PROJECTS EU] REserviceS D2.2 Ancillary services: technical specifications, system needs and costs and REserviceS D2.3 Ancillary services costs for different services and different conventional generators

REserviceS D3.1 Capabilities and costs for ancillary services provision by wind power plants REserviceS D4.1 Capabilities and costs for ancillary services provision by PV systems. All these documents are available on the REserviceS project website: http://www.reservices-project.eu/publications-results/

[SEC 13] Smart Energy Collective, An introduction to the Universal Smart Energy Framework, version 0.5, 2013, available at: http://ec.europa.eu/energy/gas_electricity/smartgrids/doc/xpert_group3_summary.pdf

[SEDC] Smart Energy Demand Coalition, A Demand Response Action Plan For Europe, Regulatory Requirements and Market Models, Brussels, 2013. Demand Response Action Plan for Europe

[Stedin] The concept of Energy Grid Services; input for discussion and inspiration for the 2014. EG report; February. 2014, Peter Hermans http://ec.europa.eu/energy/gas_electricity/smartgrids/doc/xpert_group3_energy_grid_services.pdf

[THINK] FP7 project Think, Topic 11 Final Report, 'Shift, Not Drift: Towards Active Demand Response and Beyond', June 2013, available at: http://www.eui.eu/Projects/THINK/Documents/Thinktopic/Topic11digital.pdf

[THINK] FP7 project Think, Topic 12 From distribution networks to smart distribution systems: Rethinking the institutional organization of European DSOs, Final Report June 2013, available at: http://www.eui.eu/Projects/THINK/Documents/Thinktopic/Topic12digital.PDF

[THINK] FP7 project Think, Topic 8 Electricity Storage: How to Facilitate its Deployment and Operation in the EU, Final Report, June 2012 Link: Electricity Storage