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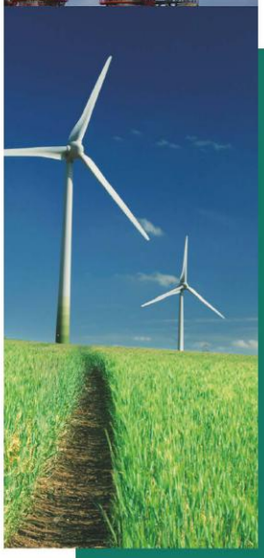

Economic and Monetary Affairs

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The Potential of Electricity Demand Response

Study for the ITRE Committee

EN

2017

The Potential of Electricity Demand Response

DIRECTORATE GENERAL FOR INTERNAL POLICIES

POLICY DEPARTMENT A: ECONOMIC AND SCIENTIFIC POLICY

WORKSHOP

The Potential of Electricity Demand Response

Brussels, 30 May 2017

PROCEEDINGS

Abstract

This report summarises the presentations and discussions made during a workshop on 'The Potential of Electricity Demand Response' organised on 30 May 2017 by Policy Department A for the Committee on Industry, Research and Energy (ITRE). The aim of the workshop was to highlight the role and potential of electricity demand response in achieving the EU energy and climate policy targets, to illustrate the current experiences and progress towards deployment of demand response across the EU and to identify and evaluate possible legislative and regulatory initiatives to optimally deploy the potential. The presentations and proceedings of this workshop should support the ITRE members in their evaluation of the related legislative proposals in the "Clean Energy for All Europeans package".

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LIST OF ABBREVIATIONS

DR	Demand Response
CEER	Council of European Energy Regulators
CREG	Belgian Federal Commission for the Regulation of Electricity and Gas
EP	European Parliament
EU	European Union
ITRE	Industry, Research and Energy
MW	Megawatt
MS	Member State
SEDC	Smart Energy Demand Coallition
TSO	Transmission System Operator

EXECUTIVE SUMMARY

The Committee on Industry, Research and Energy (ITRE) of the European Parliament organised a workshop on 'The Potential of Electricity Demand Response' which was held on the 30th May 2017. The workshop was chaired by Mr. Jaromir KOHLÍČEK, Vice-Chair of ITRE. In his introduction, he highlighted the important potential contribution of demand response to balance the European electricity system. He went on to say that in order to cope with increasing volumes of electricity from intermittent renewable energy sources, the old "electricity generation follows consumption" paradigm is no longer applicable. The whole electricity system, both supply and demand, should become more flexible in order to cost-efficiently ensure a constant balance between demand and supply. In this context, electricity demand response (which is defined as changes in the electricity use patterns of end-users triggered by price signals or incentive payments) can, and should, play an increasing role.

The first speaker was Mr. Ronnie BELMANS, Professor at KU Leuven, CEO of EnergyVille and Director of the Global Smart Grids Federation. He focused on the potential of demand response as a resource provider (energy, capacity and ancillary services), as a facilitator for enhanced competition and better price formation and as a means to catalyse innovation in smart technologies. He also noted that demand response can be used to reduce or to increase electricity demand, and that its aim is to reduce imbalances between consumption and generation. Demand flexibility can be found in a broad range of applications and different kinds of end-users. In the large industry sector, demand response has been applied at a large scale for a long time, for example in the steel and paper sectors, but there is still room for further deployment. In the residential and tertiary sectors, the potential is also high (heating, cooling, home appliances, charging of electric vehicles); however, its implementation in these market segments depends on the design of the regulatory framework, markets and products. Professor Belmans concluded that, in order to stimulate the deployment of demand response, "flexibility friendly" legislation should be implemented in all EU Member States, a standardised framework should be developed, guidelines should be provided to assess the system flexibility needs and demand response flexibility value, consumers' awareness should be enhanced and the market and regulatory distortions should be mitigated.

The second speaker was Mrs. Jessica STROMBACK, Chairwoman of Joule Assets Europe AB and the Smart Energy Demand Coalition. She explained that both explicit and implicit demand response can offer flexibility and illustrated this with some real-life examples of demand response actions in several European countries. She highlighted that the current situation is quite different across the EU: some Members States still do not have an enabling legal framework, while in other countries the development of demand response is well advanced thanks to smart metering and dynamic pricing. Mrs. Stromback concluded by highlighting some policy recommendations: open up electricity markets for all flexibility solutions, provide fair market access for all actors and service providers, allow effective price signals at wholesale and retail level, facilitate relevant data access for all service providers and enable and stimulate network operators to procure flexibility via the market.

The third speaker was Mr. Charles VERHAEGHE, Vice-President of Compass Lexecon. He focused on the different values and services provided by demand response and made the point that market response can bring significant value in the power system. Because of this value he felt that demand response should be allowed in all market segments and that the market design should not put any barriers in place. In this context, demand response operators (consumers, aggregators) should not have to request the suppliers' consent to be allowed to offer demand response flexibility to the market or to grid operators. He went on to say that as demand response leads to a transfer of energy, it seems legitimate that the supplier is remunerated for the energy initially sourced for its customers, even though part of it is not consumed due to demand response. This is a critical issue in the new Package,

which should be thoroughly assessed. Mr. Verhaeghe concluded that, beyond these general principles, many aspects of the market design need to be adapted to demand response, in order to effectively allow its large-scale development. He urged the TSOs and regulators to focus on these issues.

The fourth speaker was Mrs. Marie-Pierre FAUCONNIER, Chairwoman of CREG and Vice President of CEER. She began by describing the European energy market context and the strong growth in the use of renewable energy sources. In this context demand response, typically assisted by smart meters, can improve the way in which the market functions and energy efficiency. She highlighted the fact that the European regulators support the following Clean Energy proposals: the principle of addressing barriers to flexibility, the possibility for consumers to value their flexibility potential, the requirements for demand response participation to be based on market needs and the provision that all market participants should be held responsible for imbalances they cause. Mr. Fauconnier concluded that there is some scope for improvement in the package: a more holistic approach is recommended, the benefits of independent aggregators should be duly recognised and the relationship between aggregators and suppliers should be clarified.

The last speaker was Mrs. Kristine FIKSEN, Partner at Thema Consulting Group. She began by saying that demand response can contribute to a power system which works better and to lower electricity costs and prices. She also focused on some best practices in encouraging consumers to participate and illustrated the high potential impact of demand response with some concrete figures for the Nordic market, where demand response enabled a peak load reduction of up to 12% (representing 8,300 MW). She added that, at the moment, it is mainly industrial players that provide an impressive amount of demand response to the market, while households still play a minor role.

The Chairman concluded the session and highlighted the relevance of electricity demand response in the current and future context of the energy system. He added that these high-level presentations will offer relevant input to the ITRE members for their evaluation of the Clean Energy for All Europeans package, which was published by the European Commission in November 2016 and is currently being reviewed by the European Parliament and Council.

WORKSHOP PROCEEDINGS

Opening Remarks

Jaromír Kohlíček, ITRE Vice-chair

The workshop was chaired by Mr. Kohlíček, who welcomed the speakers. He highlighted the importance of electricity demand response in the electricity system which has substantially changed in the latest decades, with the shift from large scale power plants to more decentralised electricity generation and with consumers also becoming producers, e.g. via photovoltaic panels. Due to the generation of increasing volumes of electricity from intermittent renewable energy sources – mainly wind and solar power – the old "electricity production follows consumption" paradigm is no longer applicable. The whole energy system, both supply and demand, is becoming more flexible in order to ensure the demand-supply balance at any moment. In this context, electricity demand response can and should play an increasing role, along with existing and new flexible generation and storage technologies, such as pumped hydro and hydrogen.

The chairman also referred to the Resolution of the European Parliament which called for the strong empowerment of electricity consumers to become active participants in the market. Consumers could, for example, be encouraged to shift part of their consumption to off-peak hours and benefit from lower tariffs during that period.

The workshop is intended to provide relevant input to the EP ITRE Committee.

1.1. Possible role, potential and barriers for demand response in the EU electricity system

Ronnie Belmans, CEO EnergyVille / Professor at KU Leuven / Executive Director Global Smart Grid Federation

Mr. Belmans began by describing the changing energy world, and the evolving electricity system in particular, which is coping with unprecedented challenges. Highly unpredictable electricity flows have to be managed properly to get supply and demand aligned at any moment. Imbalances in the system mainly result from unplanned fluctuations in production and consumption. The more the intermittent renewable energy based capacity is available in the electricity system, the more the feed into the system is unpredictable and variable, and the more imbalances between supply and demand can occur. There are a lot of ways to prevent and reduce these imbalances with demand response. Demand response is a change in usage patterns by means of price signals or incentives. It can optimise the use of the power system by changing the load in time and in magnitude (not only load reduction, but also demand increase, e.g. when the output of intermittent power generation technologies is peaking).

Electricity end-users can provide readily available flexibility (e.g. household appliances are a potential source for demand response), which is fast acting and scalable and can be offered to system operators and commercial players.

The potential of demand response as a resource provider (energy, capacity and ancillary services) is high; demand response also acts as a facilitator for enhanced competition and better price formation and as a way to catalyse innovation in smart technologies.

Demand flexibility can be found in a broad range of applications and different kinds of end-users. In the large industry sector, demand response has been applied at a large scale for a long time, for example in the steel and paper sectors, but there is still room for further

deployment. In the residential and tertiary sectors, the potential is also high (heating, cooling, home appliances, charging of electric vehicles); however, its implementation in these market segments is still rather low in most EU Member States with this being hindered by the design of the regulatory framework, markets and products.

The main challenges are related to technology (need for internet of things, storage), markets (enhance competition, introduce new products and services via e.g. aggregators) and legislation/regulation. Demand response can provide flexibility across wholesale and balancing markets and catalyse innovation. Sources of flexibility are available in the residential sector, in SMEs, and in large industries. All three major groups of consumers can provide flexibility. Legislators should explore these opportunities and take appropriate measures to unlock the potential.

Several EU countries have a high demand reduction potential, and some member states also have a potential for load increase during periods when cheap power from e.g. wind and solar energy installations is abundantly available.

Mr. Belmans concluded that, in order to stimulate the deployment of demand response, "flexibility friendly" legislation should be implemented in all EU Member States (consumers need to have access to smart metering data and dynamic pricing), a standardised framework should be developed, guidelines should be provided to assess the system flexibility needs and demand response flexibility value, consumers' awareness should be enhanced and the market and regulatory distortions should be mitigated. Demand response will become a central part of the evolution of the power system. Demand is no longer driving the system, as it is now following generation. Electric vehicles will play a major role as a flexibility source to both increase and reduce demand and hence contribute to balancing the electricity system.

1.2. Current status and expected progress towards deployment of demand response in the EU

Jessica Stromback, Chair of Joule Assets Europe AB and SEDC

Mrs. Stromback began by presenting SEDC; it is an association which supports the deployment of demand response and the active involvement of consumers in the energy market. She went on to make the following points:

Demand response is key to empowering consumers to shift their load on the basis of grid tariff or market price signals and to become active participants in the market and reap the benefits of being flexible. It is similar to any form of generation, but it is consumer powered. End-users shift their load and this flexibility is sold as a resource to the market.

Demand response can contribute to the development of consumer centric and efficient markets in Europe.

Mrs. Stromback highlighted the differences between two types of demand response:

- **Implicit**: customers adjust their consumption to variable market price signals. This type of demand response is not measured or ordered in advance. Dynamic retail prices (in accordance to prices in the wholesale market) allow consumers to adjust their consumption if they deem it appropriate, either via personal choices, or via automated processes. Dynamic retail pricing contracts are offered in, amongst others, Finland and Norway, and when consumers react to price signals, the overall price levels go down. In a retail market without dynamic prices, suppliers include an insurance premium to keep prices flat. If retail prices are dynamic and follow the wholesale market, retailers do not need to charge an insurance premium against price volatility, and hence consumers benefit from overall lower bills.

- **Explicit:** this type of demand response is explicitly sold, directly or via an aggregator, to the market or to grid operators, and is used as capacity or energy to balance the system. The consumer sells a specific amount of flexibility (downwards or upwards) at a certain time and is paid in the same way as a generator. This type of transaction is subject to specific measurement and verification processes.

Both types of demand response serve different purposes.

Price or incentive based demand response can participate in several markets, in particular the month or day-ahead and intra-day wholesale market segments, and the procurement of ancillary services.

Mrs. Stromback then provided some real-life examples of explicit demand response in Europe:

- A water treatment installation of Vivaqua can shift its demand by 3 minutes in order to avoid activating a coal power plant.
- Sainsbury's supermarkets: 200 stores are equipped with flexible air-conditioning units.
- ArcelorMittal can temporality reduce its electricity demand for industrial processes by 150 MW and offers this flexibility to the balancing market.

She also presented some examples of implicit demand response:

- 10,000 consumers in Switzerland react to price signals via their PV and home automation systems.
- In Finland, hourly retail electricity prices are offered and can be coupled to smart home controls.

The roll out of smart meters is an important part of the basis for the development of demand response, but the commercial and regulatory framework should also enable and facilitate it. This is still a problem in several EU member states: in Spain for instance consumers are still not allowed to participate in the market, and there is also not yet an enabling legal framework in Italy, although the Italian authorities are currently considering working on it.

She concluded her presentation by highlighting the SEDC policy recommendations: electricity markets should be opened up for all flexibility solutions, fair market access should be provided for all actors and service providers, effective price signals should be allowed at wholesale and retail level, relevant data access should be facilitated for all service providers and network operators should be enabled and stimulated to procure flexibility via the market.

Demand response is already proven and largely developed in some European countries, but what is needed now is to allow and stimulate its larger scale development in all EU member states, by providing a uniform legal framework which offers all EU consumers the same rights and opportunities.

Questions & Answers

A question was raised regarding the legality issue, the criteria for service providers, and the awareness of energy consumers. As awareness is an important element to ensure that consumers understand demand response, the questioner wondered what initiatives could be taken to increase education, awareness and acceptance of demand response and flexibility.

Mrs. Stromback suggested that demand response should not be imposed, but consumers should be able to choose it and benefit from it. A government programme to raise awareness would be expensive and unnecessary. If there is market competition with adequate offerings, demand response will take off, as shown in the US and in some EU member states.

Mr. Belmans added that the most important condition to enable and facilitate demand response is an adequate tariff system; an energy based tariff on a large timescale will be less efficient in triggering demand response than capacity based horizontal tariffs. Consumers should be made aware that, if they reduce or increase their capacity offtake from the grid, they get a benefit via a more appropriate tariff. Competition is also important to offer adequate products and technologies.

1.3. How should the design and functioning of electricity markets and procurement of ancillary services be adapted to optimally value the potential of demand response?

Charles Verhaeghe, Vice-president Compass Lexecon

Mr. Verhaeghe began by presenting the principles of demand response. Electricity consumers can offer different kinds of flexibility services, depending on what equipment they have, where they are located, etc. End-users can provide energy value (adapt their load to balance the system and hence reduce the overall price of energy), flexibility value, services to the network (i.e. constrain load in peak periods locally to avoid congestion) and capacity value (ensure system and supply adequacy by demand peak reduction rather than in investing in new peak plants).

End-users have different approaches to offering value from their demand response:

- provide flexibility to grid operators,
- provide flexibility to their suppliers which allows them to minimise their electricity bill, and
- conclude a specific contract with an aggregator that can value this flexibility in different markets.

By offering demand response to the market, consumers can enter into competition with suppliers, generators or aggregators.

Mr. Verhaeghe then referred to the legal framework at EU level, and in particular to the proposal of the European Commission in the Clean Energy for All Europeans package which contains principles on how the market should be designed to enable demand response. Relevant legal provisions are also included in the Energy Efficiency Directive and the State Aid guidelines, but this existing legal framework is not sufficient to enable a large scale deployment of demand response.

Despite the high potential of demand response in the EU and despite the provisions in the current EU legislation, only a few countries have implemented an enabling framework to take advantage of it. A lot of work needs still to be done to fully capture the potential.

In the (new) electricity market design, proposed by the European Commission, aggregation and demand response should be allowed to participate in all markets, consumers or aggregators wouldn't have to ask for the consent of the supplier, aggregators would not be required to pay compensation to suppliers, but compensation could be envisaged between aggregators and balancing responsible parties.

Mr. Verhaeghe supported the idea that an explicit consent of the supplier is not necessary, but wondered whether the proposal of the Commission with regard to the potential compensation is adequate. The intervention of an aggregator will indeed lead to a transfer of energy from responsive consumers to others, and as this transfer has an impact on the portfolio of the suppliers concerned, a proper remuneration should be envisaged, and this also ensures that the overall system efficiency is maximised. Demand response should contribute to balancing the system, if there is a mismatch between demand and supply; at

that moment the flexibility options are to increase supply or reduce demand, or vice versa, in order to balance the system. It is important to have enabling rules for demand response, but they should not be detrimental to other market parties, particularly generators and balancing responsible parties.

Mr. Verhaeghe then presented his recommendations with regard to the market design for demand response, these were:

- demand response can offer high added value and should be allowed in all market segments,
- fair competition between aggregators (get an incentive to provide flexibility) and suppliers (do not always have an incentive to provide flexibility) is necessary,
- physical transfer of energy between market parties should be properly treated. In his view, the proposal of the Commission should probably be adapted. At the same time the solution needs to be pragmatic, to make sure it can be developed fast and that the costs to manage the system are limited.
- Many aspects of the market design need still to be adapted, and proper rules need to be defined for the different concrete types of demand response. This review should be undertaken by authorities and regulators, in close cooperation with grid operators and market parties.

Questions & Answers

The chair of the session raised a question with regard to the definition of an aggregator. Mr. Verhaeghe clarified that an aggregator is a third party – a separate entity – that bundles the available flexibility of several grid users and offers it to market or grid operators. An aggregator is hence an intermediary that values flexibility of individual market players.

Another question referred to the compensation issue. Imposing compensation could be considered as an adequate measure from an economic perspective, but to what extent would it constitute a barrier for the development of aggregators in the market?

Mrs. Stromback replied that the technical explanation is accurate, and that retailers have in principle valid arguments to claim compensation. The issue is however achieving proportionate legislation, which ensures that the benefits of demand response are fairly allocated to the concerned market parties. To illustrate this problem, she referred to the situation in France where a (too) high share of the benefits of demand response was allocated to retailers to the detriment of aggregators. Legislation should be proportional, and take into account the social benefits and the specific interests of both retailers and aggregators.

Mr. Belmans argued that regulation should be technology neutral which means that storage, generation and demand response should be treated equally. Rules with regard to the calculation and compensation of the impacts of demand response, should be pragmatic and not lead to disproportionate administrative costs that undermine the economic benefits of demand response.

Mr. Verhaeghe added that a pragmatic approach is necessary. If demand response is only implemented at small scale and for limited purposes, market distortions due to the transfer of energy would be limited, and it might not be proportionate to introduce specific rules for compensation. However, if demand response was used at a large scale to value the flexibility of, among others, batteries in homes and vehicles during longer periods of the year, there might be a stronger argument to consider the distortions between market parties.

1.4. How can the Clean Energy for All Europeans package improve the legislative framework for demand response?

Marie-Pierre Fauconnier, Chair CREG and Vice-president of CEER

Mrs. Fauconnier began by highlighting the membership (35 European regulators) and role of CEER and then pointed to the recent and rapid changes of relevance, in particular the deployment of new (smart) technologies, the importance of cybersecurity, the development of renewable energy and the liberalisation of the energy markets, all of which implies the need for regular updates of the legislation and regulations.

Renewable energy sources already account for 28% of the EU electricity demand and this should rise to 50% by 2030. In order to cope with their intermittent nature, more flexibility is needed to manage the electricity system. To provide flexibility to the market and to the system, there are several options, including demand response at the retail level.

CEER is in favour of demand response as it offers substantial economic, societal and technical benefits:

- It enables and improves consumer engagement, and for CEER the customer should be at the centre of the energy system.
- It helps to manage intermittent renewable energy sources.
- It lowers peak and overall demand and hence leads to lower electricity bills.

Demand response, typically assisted by smart meters, can improve the way in which the market functions and energy efficiency. A fair allocation of the system costs to the different grid users is necessary in order to avoid distortions and to minimise the overall system costs; in this view prosumers (those who produce and consume) also need to pay a fair share of the network and system costs, and net metering should be avoided. Bidirectional meters should be installed to separately measure consumption and production.

She then referred to the position (endorsed in a specific CEER White Paper) of the Council of European regulators with regard to the Clean Energy package published in November 2016. CEER supports the following proposals:

- the principle of addressing barriers to flexibility,
- the possibility for consumers to value their flexibility potential.

In this context she referred to a previous question and suggested that awareness should indeed be raised, and that end users should be better and more informed, in order to avoid loosing part of the population as potential providers of flexibility. Providing the right information to consumers is part of the responsibility of the regulator.

- The requirements for demand response participation to be based on market needs, and
- the provision that all market participants, including independent aggregators, should be held responsible for imbalances they cause.

Mrs. Fauconnier concluded that there is some scope for improvement to the proposed provisions in the package: CEER recommends a more holistic approach where all consumers have the opportunity to participate in all relevant markets to value their flexibility, either directly or via an aggregator, the benefits of independent aggregators (not affiliated to suppliers or other market parties) should be duly recognised and the relations between aggregators and suppliers should be clarified. The position of aggregators should not be foreclosed by suppliers.

With regard to the question on compensation between aggregators and suppliers, Mrs. Fauconnier added that the CEER position does not envisage compensation, but Member States can exceptionally implement a compensation scheme.

Mrs. Fauconnier concluded by giving an overview of some other relevant CEER positions.

1.5. Best practices on how to make electricity end users active and efficient market participants and how to reward them for their flexibility – Examples from the Nordic market

Kristine Fiksen, Partner Thema Consulting

Mrs. Fiksen began by saying that demand response can contribute to a power system that functions in an improved way and to lower electricity costs and prices. The market for demand response consists of several segments with different characteristics, and also with different time frames. Electricity markets function on the basis of the consumption and generation activities of millions of players, and it is impossible to correctly predict/assess how they will act/react. It is however crucial that demand meets supply at every moment, in order to avoid imbalances which might in the worst scenario lead to black outs. System operators take ex-ante measures to avoid/prevent imbalances, and handle residual imbalances in real time. Market participants are incentivised to contribute to balancing the system by rewards (positive) or penalties (negative).

She then focussed on some best practices in activating consumers and illustrating the high potential impact of demand response with some concrete figures for the Nordic market. In the Nordic system both generation and demand side participate in the market on a level playing field. Hourly retail electricity prices are fixed for the next day; end-users can avoid the impact of price spikes on their bill by adjusting their consumption. This pricing system acts as an incentive for end-users, in particular industry, to offer demand flexibility. Therefore, end-user prices should not be capped, otherwise consumers, and in particular industry, would be less interested in offering their flexibility.

Mrs. Fiksen showed concrete figures for two specific days in 2010 and 2015 with high market prices: at that moment respectively 17% and 11% of the overall demand was price dependent, and the effective load reduction triggered by demand response amounted to respectively 12% (representing 8.300 MW) and 3.2% of the peak demand. The resulting price levels were significantly lower and both active and inactive consumers benefitted from this price effect.

In order to enable demand response, smart meters, price incentives, and timely available market and consumption data are needed. The Nordic markets are getting there, particularly Norway, which is the first to have real time pricing and smart meters and will hence be able to develop demand response at a large scale in the retail market. At this moment, mainly industrial players are providing the Nordic market with an impressive amount of demand response, while households are still playing a minor role.

She then focussed on the impact of price and tariff signals on demand response. Retail prices should not be administratively set or capped, because they might give the wrong signals to market parties, and overrule market prices. Grid tariffs should be administratively set, but only limit markets at times without sufficient grid capacity. If grid tariffs give proper incentives at the right moment, conflicting tariff and price signals are not problematic. Grid and system management should be coordinated between TSOs and DSOs. DSOs can avoid investments in grid infrastructure by using flexibility available in the retail market to prevent grid congestion; a Norwegian DSO has for instance set up a project with Microsoft to avoid investing in a transformer station: 30-40 small industrial consumers (> 3 MW) offer their

flexibility a day ahead via a fully digitalised system and the DSO can choose the cheapest offer to solve its local problems.

Mrs. Fiksen concluded that planning is crucial (preventing imbalances in real time is more expensive and risky than reducing imbalances beforehand via the market), authorities should allow the demand side to participate in all market segments, grid tariffs should be properly set and retail prices should not be regulated, service providers and aggregators should be enabled to play an active role in the market, and demand response should be enabled by smart meters, timely and wide availability of market data and dynamic retail prices.

Questions & Answers

Mr. Nicola Riga, a representative of the European paper industry association CEPI, referred to the large potential of demand response in the paper industry and confirmed that this potential is already valued in several member states. In order to further deploy demand response across the EU, authorities could wait for the full implementation of the new package in all EU member states, which might take several years, or they can accelerate this process by focusing on the most advanced countries. Which approach would the panel members recommend?

Mrs. Fauconnier replied that the new legislative package could be approved quite rapidly, but that member states should not wait for this approval to take appropriate legislative and regulatory initiatives to effectively unlock the potential of demand response. In Belgium for instance, an enabling legal and regulatory framework is already in place and demand response is developing.

Mrs. Fiksen referred to the fact that, if new markets for demand response have to be set up, a chicken-egg situation might occur. Market participants cannot be attracted without adequate market rules and products. Therefore, concrete tests can be efficient to set up a market for demand response.

Mr. Belmans thought that, by leaving the development of demand response to the market, there is no need for extensive and specific new legislation; demand response, storage and generation should be considered on an equal footing as possible sources for balancing energy and capacity.

Mrs. Stromback suggested the paper industry should act now; several EU markets are already open, and the paper industry can participate in demand response without having to wait for new legislation. Basic legal provisions are already available in the Energy Efficiency Directive and some further rules will be included in the network codes which are being reviewed. For demand response activities of industrial end-users, there is no longer a need for public investments in e.g. metering and communication infrastructure; there are only some regulatory barriers which should be addressed. For residential end-users however, further public investment in smart meters, communication technology, etc. is needed.

Mr. Verhaeghe confirmed that the current legislation already presents a proper basis for demand response. Grid operators and regulators need to ensure that demand response, generation and storage are put on an equal footing.

Closing Remarks

Mr. Jaromír Kohlíček confirmed that the full roll out of smart meters is a preliminary condition for a large-scale development of demand response in the retail market. He considered that the presentations give a comprehensive and rather optimistic view on the (possible) development of demand response, and thanked the speakers for their interesting and important input.

ANNEX 1 AGENDA

Workshop on

The Potential of Electricity Demand Response

Organised by the Policy Department A Economic and Scientific Policy
for the Committee on Industry, Research and Energy (ITRE)
European Parliament, Brussels
30 May 2017, 13:30 to 15:00
Room: Altiero Spinelli 3G-2

13:30 – 13:40 Introduction by Jaromír Kohlíček, ITRE Vice-chair

13:40 – 13:55 Possible role, potential and barriers for demand response in the EU electricity system

Ronnie Belmans
CEO EnergyVille / Professor at KU Leuven / Executive Director Global Smart Grid Federation

13:55 – 14:10 Current status and expected progress towards deployment of demand response in the EU

Jessica Stromback
Chair of Joule Assets Europe AB and Smart Energy Demand Coalition (SEDC)

14:10 – 14:25 How should the design and functioning of electricity markets and procurement of ancillary services be adapted to optimally value the potential of demand response?

Charles Verhaeghe
Vice-president Compass Lexecon

14:25 – 14:40 How can the Clean Energy for All Europeans package improve the legislative framework for demand response?

Marie-Pierre Fauconnier
Chair of the Belgian federal Commission for the Regulation of Electricity and Gas (CREG) and Vice-president of the Council of European Energy Regulators (CEER)

14:40 – 14:55 Best practices on how to make electricity end users active and efficient market participants and how to reward them for their flexibility

Kristine Fiksen
Partner Thema Consulting

14:55 – 15:00 Concluding remarks by Jaromír Kohlíček, ITRE Vice-chair

ANNEX 2 SHORT BIOGRAPHIES OF THE SPEAKERS

Ronnie BELMANS (CEO EnergyVille / Professor at KU Leuven / Executive Director Global Smart Grid Federation)

Ronnie Belmans received his MSc degree in electrical engineering in 1979 and a PhD degree in 1984, both from KU Leuven, Belgium. In 1989 he added a Special Doctorate from the KU Leuven and in 1993 a 'Habilitierung', from the RWTH, Aachen, Germany. Currently, Ronnie Belmans is full professor at KU Leuven, teaching techno-economical aspects of power systems, electrical energy and regulatory affairs, among others. His research interests include smart grids, security of energy supply and the techno-economic aspects of the liberalisation of the electricity market.

Within Belgium, Prof. Dr. Ir. Ronnie Belmans is vice president of the KU Leuven Energy Institute as well as cofounder and CEO of EnergyVille, a research collaboration in Genk specialising in energy in smart cities and buildings, in cooperation with VITO and Imec. Since 2017 he is chair of the board of directors of the VREG, the Flemish regulator for electricity & gas markets. Ronnie Belmans is also honorary chair of the board of directors of ELIA, the Belgian transmission system operator. On a global scale, he is executive director of the Global Smart Grids Federation (GSGF).

Jessica Stromback (Chair of Joule Assets Europe AB and Smart Energy Demand Coalition (SEDC)

As Chair of Joule Assets Europe, Jessica Stromback supports the creation of European investment portfolios for energy efficiency and demand side management projects. In this capacity, she acts as project coordinator for the EU project SEAF (The Sustainable Energy Asset Framework) an IT Platform dedicated to facilitating investment in demand side projects for a range of players, including SMEs.

Jessica Stromback is also co-founder and Chair of the Smart Energy Demand Coalition (SEDC). As Chair she works actively with European policy makers and industry representatives to enable demand side participation throughout European energy markets, through information, dynamic pricing, automation, and demand response.

Charles Verhaeghe (Vice President Compass Lexecon)

Charles Verhaeghe is a Vice President in the Paris office of FTI Compass Lexecon. He has about 10 years of experience in the energy sector and a considerable knowledge of renewable energy, energy economics and regulation.

He has been involved in several regulatory and market design assignments, in France, the UK and in many other European countries, related to the development of renewable energy and the analysis, regulation and design of their power markets, including the wholesale, retail, balancing and capacity markets. He worked on a number of projects related to capacity mechanisms, interconnectors, demand-side response, renewable energy and storage development.

Before that, Charles Verhaeghe worked six years for the CRE, the French energy regulator, where he was head of the cross-border power trade department within the grid access directorate and managed a team of economists and engineers in charge of power market design, cross-border trade, interconnectors, demand response, balancing and capacity

markets. In this regulatory role, he actively contributed to the design as well as to the implementation of the EU Target Model.

Charles Verhaeghe contributed to the establishment of a legal and regulatory framework for demand response, allowing aggregators to participate in capacity, wholesale and balancing markets: thanks to these developments, SDEC considers France as one of the most suited markets for demand response.

Marie-Pierre Fauconnier (Chair of the Belgian federal Commission for the Regulation of Electricity and Gas – CREG, and Vice-President of the Council of European Energy Regulators - CEER)

Marie-Pierre Fauconnier holds a master's degree in Actuarial Science, a master's degree in Applied Economics and a degree in Environmental Management from the Université de Mons-Hainaut and the Université Libre de Bruxelles.

She started her professional career as an assistant lecturer at the Faculté Polytechnique de Mons. She then joined a Belgian research centre in order to continue her research on utilities (including energy utilities). From 1999 to 2002 she served as deputy head of cabinet of the Belgian deputy prime minister. In 2002 she joined ELIA, the Belgian electricity transmission system operator, in the capacity of advisor to the CEO in the field of strategy. In 2006, she became head of the Directorate-General Energy of the Federal Public Service Economy.

From 2009 to 2013, she was Chair of the Governing Board of the International Energy Agency (IEA), to which she has been the Belgian representative since January 2006. From 2007 to 2013, she was Chair of the Governing Board of Brugel (the energy regulator for the Brussels region). She also worked as a government representative at various institutions: the Ondraf, the Apetra, the IRE and the AWT.

Since September 2013, Marie-Pierre Fauconnier has been the Chair of the Commission for the Regulation of Electricity and Gas (CREG). Within the limits of her duties, she represents Belgium at the Council of European Energy Regulators (CEER) and the Agency for the Cooperation of Energy Regulators (ACER). Since January 2015 Marie-Pierre Fauconnier is the Chair of the International Coordination Group (ICG) within CEER and since May 2015, she is Vice-President of CEER.

Kristine Fiksen (Partner Thema Consulting)

Kristine Fiksen is a partner at the THEMA Consulting Group and has 12 years' experience in the renewable energy industry. She specialises on system issues where technology, market and policy must work together to meet future challenges in the power or transport sector.

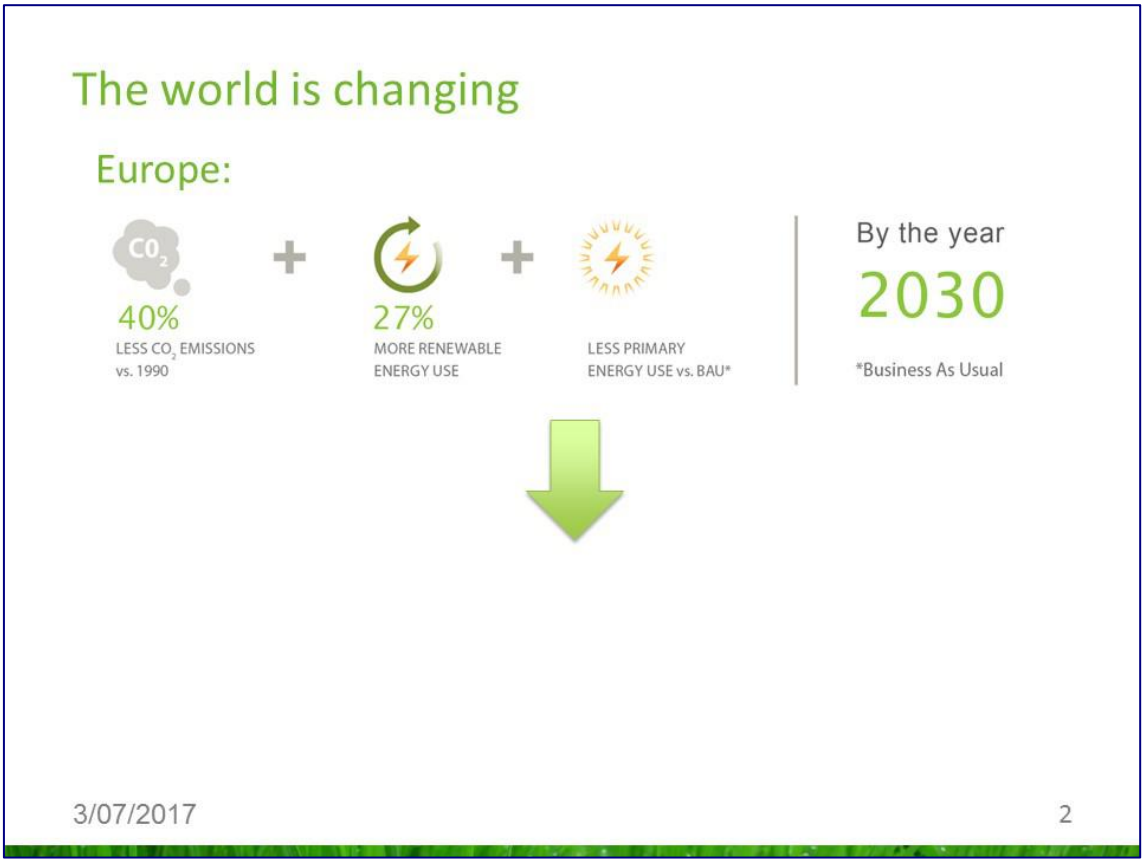
Her main experience is within demand response, energy use, end user markets, grid connection, grid tariffs and electric transport. Kristine Fiksen has played an important role in several demand response projects for Norwegian and Nordic governments in addition to the EU Commission (DG Energy). The projects have focused on how demand response measures can increase the efficiency of power markets and systems.

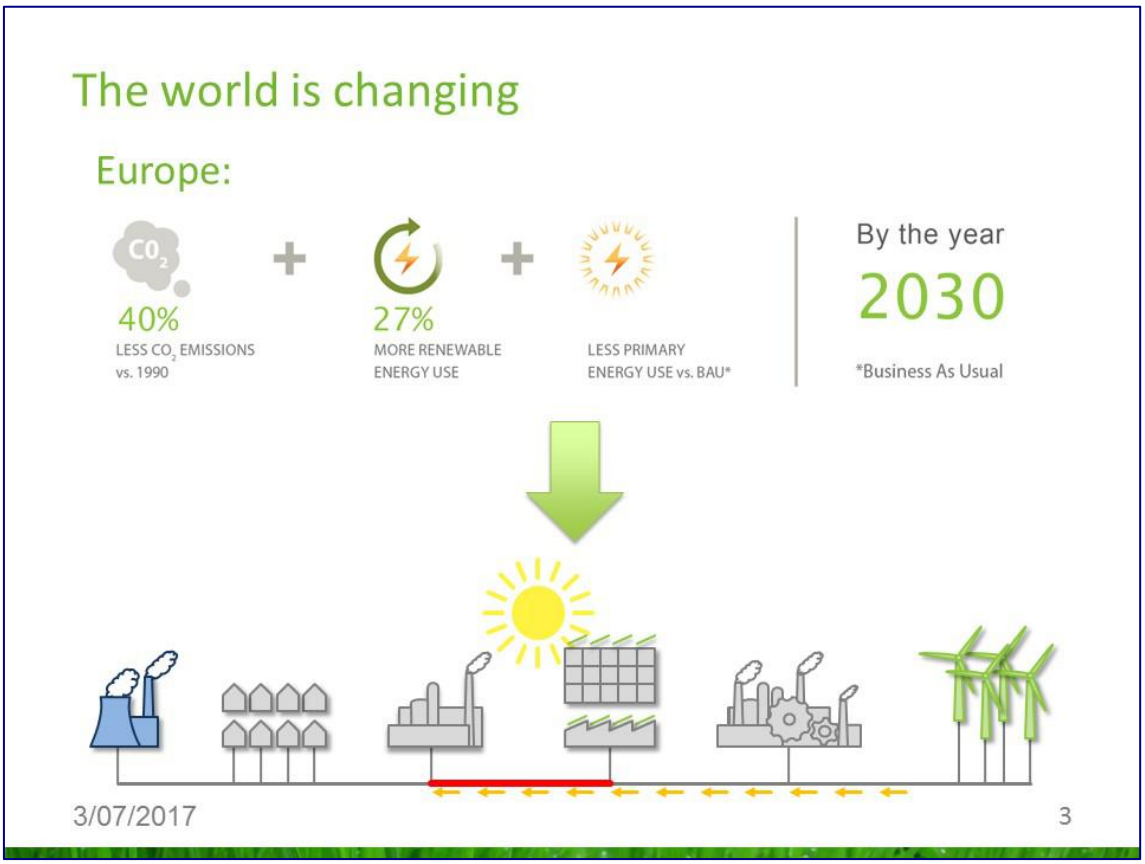
Before joining THEMA in 2010, Kristine Fiksen has worked for Econ Pöyry and Akershus Energi and seven years in the media industry, primarily with the Internet services in the Schibsted Group and Eniro.

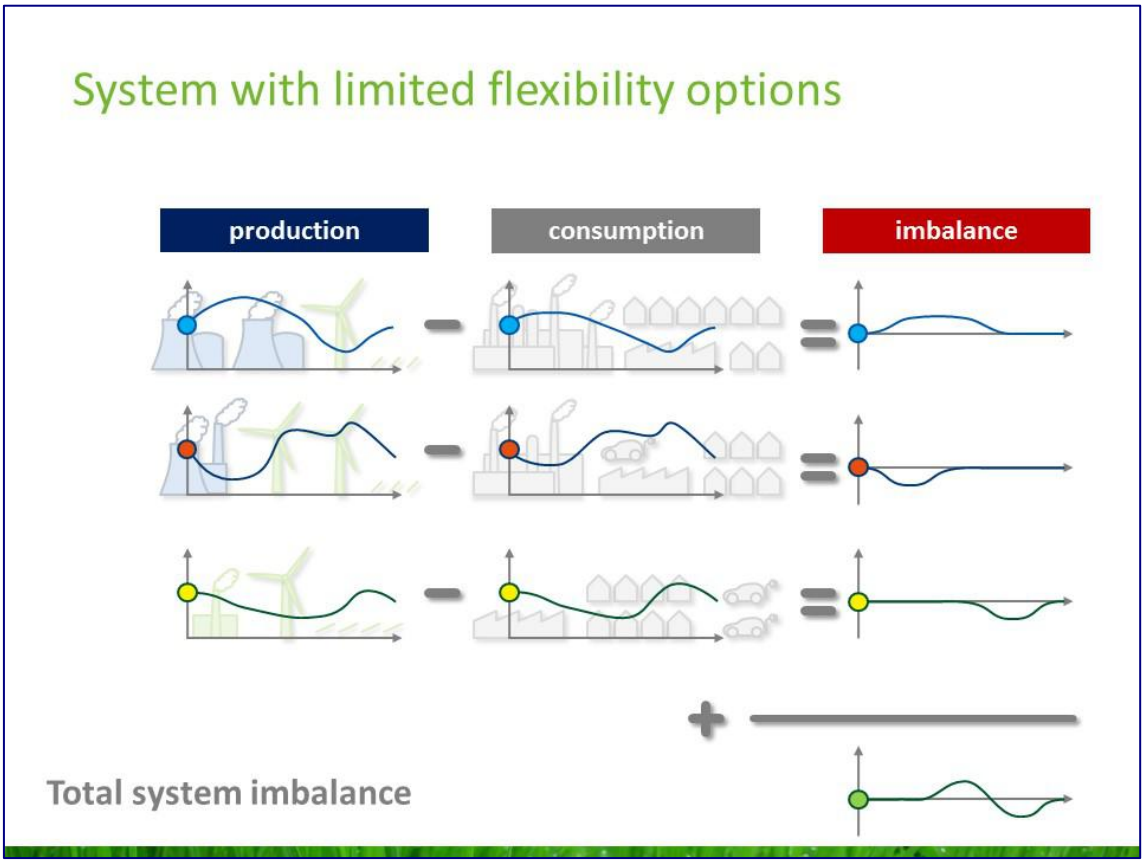
Kristine Fiksen holds an MSc in industrial management from NTNU Trondheim in 1997, specialising in energy.

ANNEX 3 PRESENTATIONS

Presentation by Mr. Ronnie BELMANS

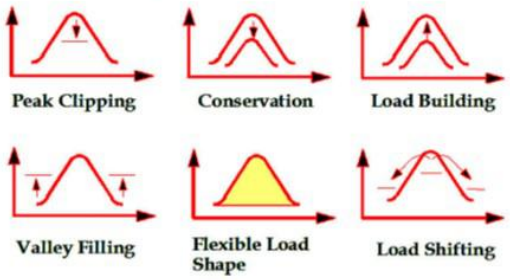



The world is changing
Europe:
40%
LESS CO_2 EMISSIONS vs. 1990
27%
MORE RENEWABLE ENERGY USE
LESS PRIMARY ENERGY USE vs. BAU*
By the year
2030
*Business As Usual
3/07/2017
3


System with limited flexibility options
production
consumption
imbalance
Total system imbalance

Demand Respond
A characterization

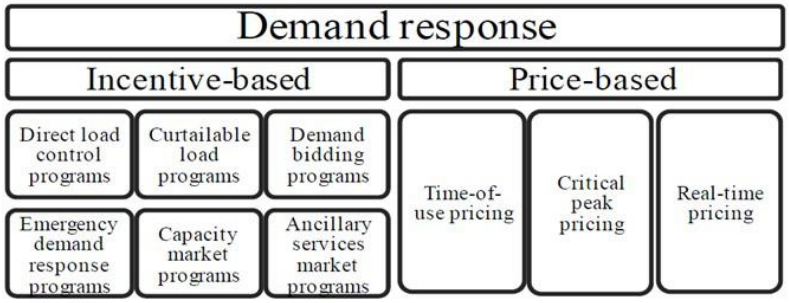
- From a high-level perspective,
  - DR could be understood as the ***change in electric usage patterns*** of end-users by means of ***price signals or incentive payments***
- DR could optimize the use of the power system
  - It is more than "just load reduction"



3/07/2017 http://www.energitix.com/projects/ 5

Demand Respond
A characterization

- Readily available flexibility
  - Each consumption device (e.g. home appliance) is a (potential) source of flexibility
- Fast acting and scalable
  - Immediate way to increase flexibility
    - For system operators
    - For commercial players
- Groups



Dupont, 2015

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Demand Response
Possible role

- In the flexibility realm
  - Resource provider - Enhancing system reliability and adequacy
    - Energy
    - Capacity
    - Ancillary services
  - Facilitator of a decarbonized power system
- In the technological realm
  - Innovation catalyzer
    - Metering / Automation (control) / Communication
    - Storage
    - Consumption behaviors (new ways to consume)
- In the market realm
  - Competition enhancer
  - Facilitator for better price formation

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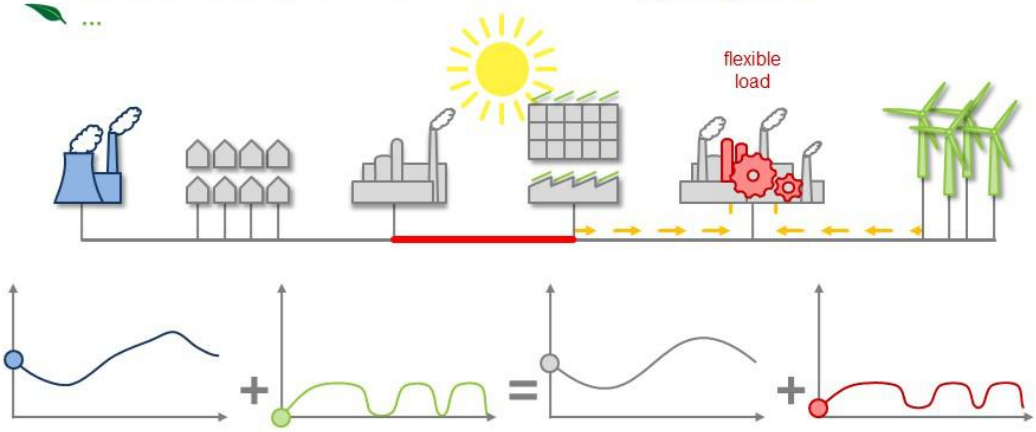
Demand Response
Possible role

- Provider of flexibility-based solutions
  - Across wholesale and balancing markets
- Innovation catalyzer
- Promoter of competition
- ...

Art. 15 from the European Commission Energy Efficiency Directive (2012/27/EU):
- Encourage DR participation in wholesale and retail markets
- Promote access and participation of DR in system services markets
- No discrimination to DR providers (aggr.) by system operators



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Demand Response
Possible sources

"Flexibility can be found in a broad range of appliances and different kinds of customers."

residential	SME & buildings	large industry
▪ hot tap water boiler	▪ air-conditioning	▪ steel industry
▪ washing machine	▪ ventilation	▪ electrolysis
▪ tumble dryer	▪ heat pump	▪ compressors
▪ dish washer	▪ cold storage	▪ pumps
▪ air-conditioning	▪ compressors	▪ paper industry
▪ heat pump	▪ pumps	▪ …
▪ charging EV	▪ …	

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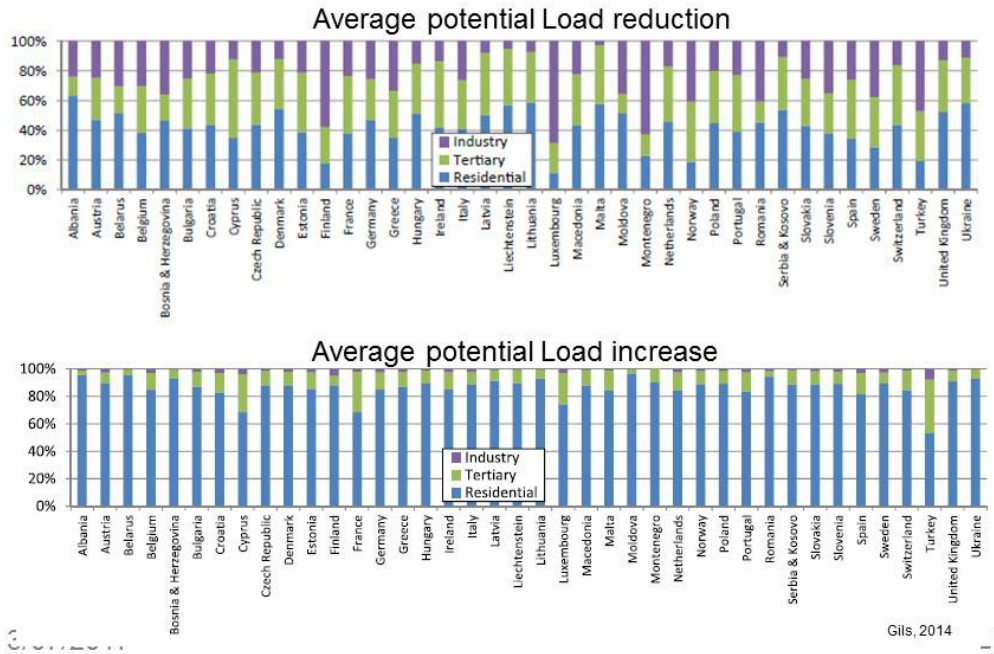
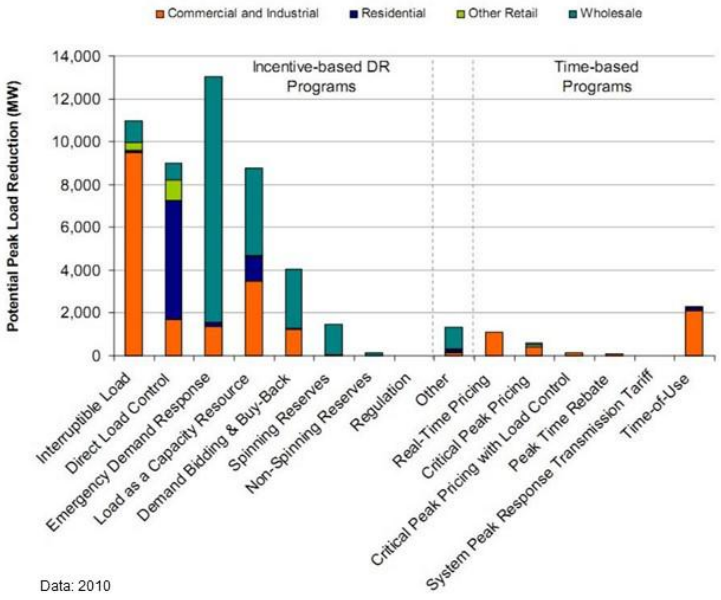
Demand Response
Potential



Gils, 2014

Demand Response
Potential



Data: 2010

Dupont, 2015

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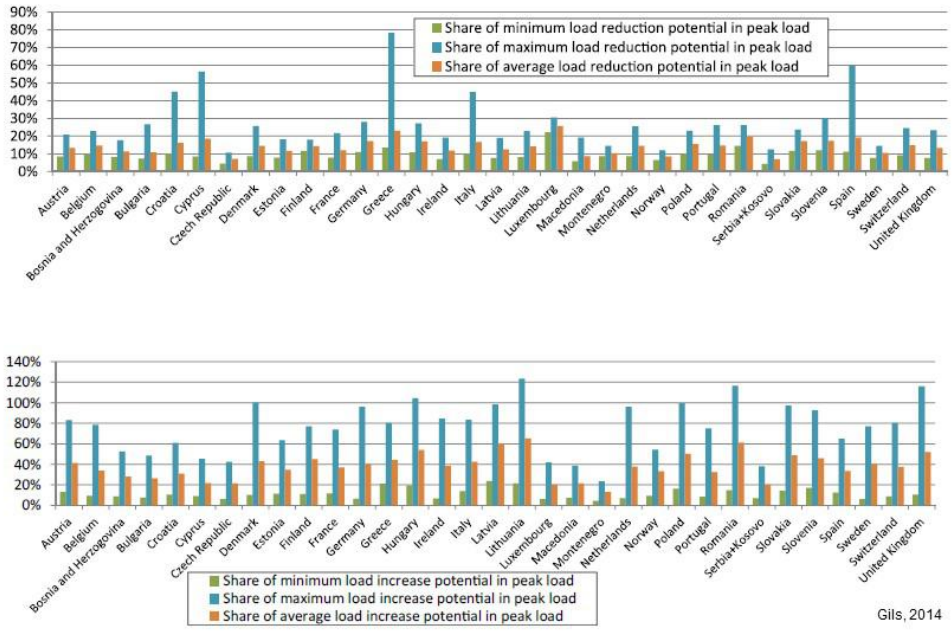
Demand Response
Potential



Gils, 2014

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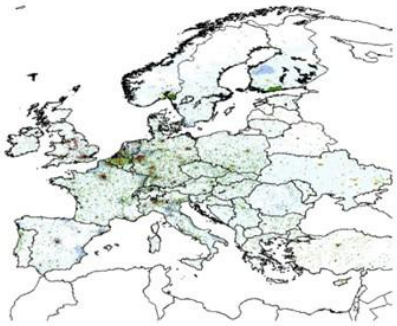
Demand Response
Potential

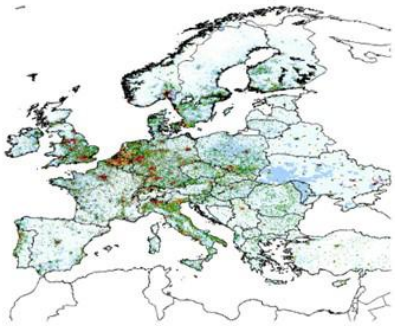
- Values of more than 900 kW/Km²
  - Paris, Inner London, Ludwigshafen am Rhein
- Low densities
  - North-eastern Germany, Scotland, northern Finland, ...

Load reduction potential



Density in kW/Km²

Load increase potential



Density in kW/Km²

< 1 kW/km²
1 - 9.99 kW/km²
10 - 24.99 kW/km²
25 - 49.99 kW/km²
50 - 99.99 kW/km²
100 - 149.99 kW/km²
150 - 199.99 kW/km²
>= 200 kW/km²

Gils, 2014

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Demand Response
Potential

Energy services

- Market parties
  - Cost savings
    - Investment and operation (power plants)
  - Market revenues
  - Renewable energy integration

- System operators
  - Maintain grid security
  - Operating reserves
    - System balancing
    - Congestion resolution

Network services

System adequacy services

- Consumers
  - Reduce investment costs
    - peak generation
  - Security of supply
    - Cost-efficient

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Demand Response
Potential

Potential business models for DR in 6 Member States

Business model		BE	FR	DE	IT	ES	UK
Standard contract optimization	Commodity	●	●	●	●	●	●
	Network charges	●	●	●	●	●	●
Day-ahead optimization	Commodity	●	●	●	●	●	●
	Network charges	●	●	●	●	●	●
Reserve capacity	FC reserve	●	●	●	●	●	●
	FR reserve	●	●	●	●	●	●
	R reserve	●	●	●	●	●	●
Imbalance optimization		●	●	●	●	●	●
On-site VRE optimization		●	●	●	●	●	●

● business case is viable in exisiting regulatory framework
● business case limited viability/restricted in current regulatory framework
● business case impossible in existing regulatory framework

IndustRE, 2016

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Demand Response
Potential

Potential to **optimize the use of the power system**
Maintaining the balance between demand and supply

- (peak) demand reduction
  - In a 2011 study ordered by the FERC (USA)
    - The vast majority of peak reduction potential will come from incentive-based demand respond (92%)
  - However, in the long run the introduction of "smart" technologies may tilt the balance towards price-based DR
- Better wholesale market price formation
  - Increases market efficiency
    - Flexible enough to substitute or complement services provided by other technologies (e.g. pumped storage)
- Improved supply of system services
  - Enhances system reliability
    - Fast enough to cope with sudden imbalances (short-term)
    - May reduce the need of investments on new (peak) generation capacity (long-term)
- Lower investment in capacity
  - Cheapest flexibility option
    - In comparison with other capital intensive options (flexible generation, storage, enhanced interconnections)

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Demand Response
Challenges

- Adequate remuneration
  - Need of price spreads in the market that makes DR profitable
    - Rather than occasional price spreads that do not allow for building a flexible tariff optimization model
  - Need of adequate peak pricing and/or rebate program
    - Peak periods: suitable announcement lead time and duration
- Requirements for participation
  - E.g. frequency of procurement, resource availability, event duration, …
- Measurement and verification protocols to ensure a fair payment for DR services
  - E.g. standardized baseline mechanism
- Clarification of relationships
  - E.g. between BRP and aggregator

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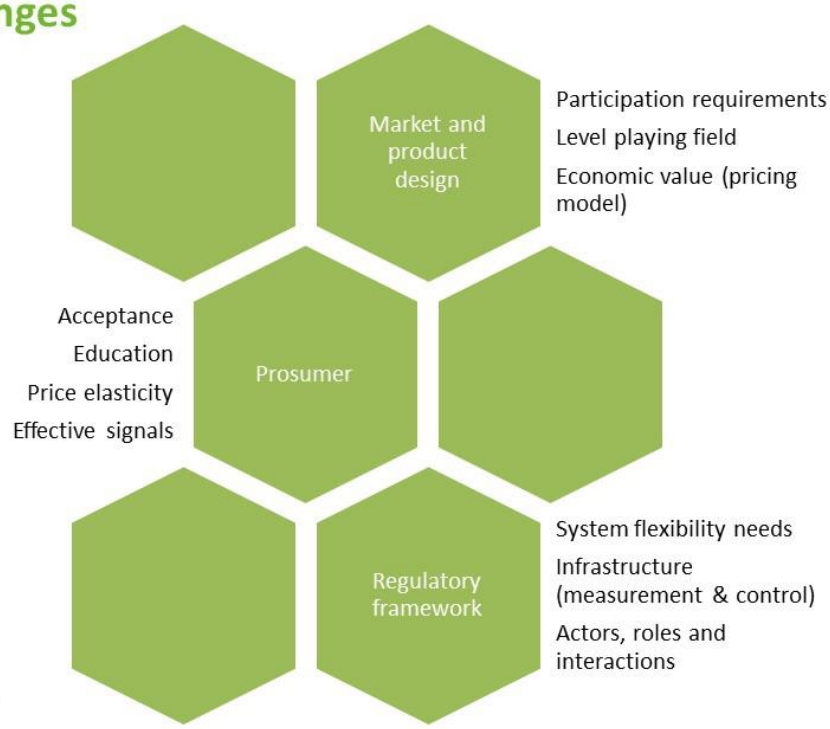
Demand Response
Challenges



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Demand Response
Challenges in practice

- Participation in balancing reserves
  - Product
    - Originating from the design of regulatory framework, market, product which focus on the characteristics of generators
      - Bid (minimum) size
      - Timing requirements: product duration & minimum run/down times
      - Symmetry
  - Economic
    - Financial (dis)incentives
      - Incentives are to low or not existing
      - Fear to increase in bill due to high peak demand usage
      - High penalties for non-compliance
  - Technical
    - Special requirements for the system or consumers (focus on generation specifics)
      - Lack of infrastructure: no smart meter = no time-varying prices
      - Network and scheduling constraints
  - Consumer
    - Lack of awareness and policy restrictions
      - Low awareness and understanding of DR programs
      - Low willingness to react to signals (prices or incentives) due to inelasticity of demand
      - No freedom to design rates (retail)
      - Wholesale prices are more variable than retail market prices

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Demand response
The take away

- DR may play a central role in the evolution of the power system
  - As resource provider
  - As innovation catalyzer
  - As competition enhancer
- DR has the potential to reshape the electricity business
  - especially at distribution system level
    - However, the value of this source of flexibility should be reflected by the financial incentives and price signals delivered to the consumer
- Participation of DR
  - System adequacy and balancing seems to be more interesting for DR
  - Wholesale has still low participation
- Main source of barriers for the deployment of DR
  - Design of the regulatory framework, markets and products
    - It is important to take into account these barriers when deciding on the scope and characteristics of any reform (e.g. IEM – market harmonization)

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Demand response
The take away

- To continue the deployment of DR it is needed to
  - Promote a "flexibility friendly" legislation
    - E.g. Providing consumers with access to infrastructure (smart meters) and schemes (dynamic pricing)
  - Support an standardized framework
  - Give guidelines to assess system flexibility needs and DR flexibility value
    - E.g. Promoting robust CBAs
    - E.g. Taking into account expected potential and related cost (e.g. methods, incentives and technologies to measure and promote changes in consumer's behavior
  - Increase consumer's awareness
    - E.g. Simplifying the message and enhancing the protection
  - Mitigate market and regulatory distortions
    - E.g. Considering solutions for DR barriers in the design of the regulatory framework, markets and products

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EnergyVille

Questions?

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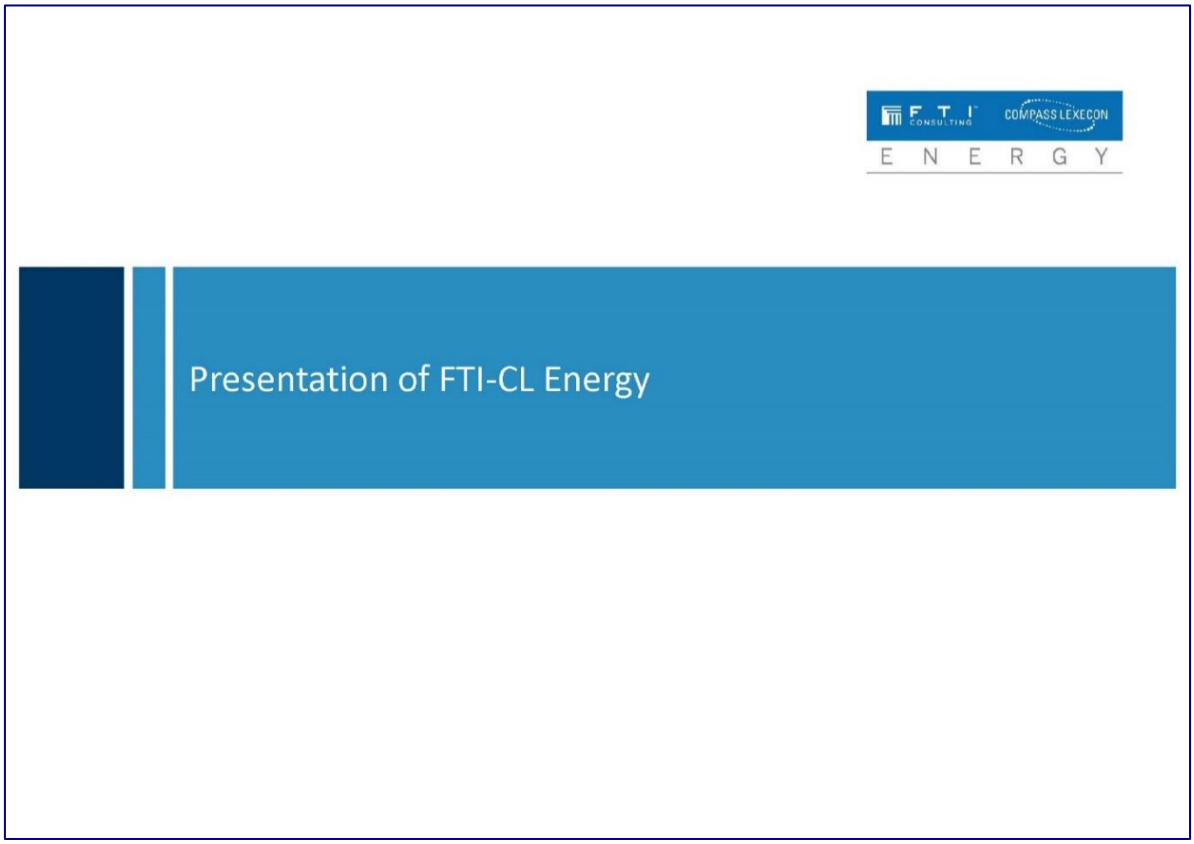
Presentation by Mr. Charles VERHAEGHE



FTI Consulting in a few words

Global business advisory firm

Dedicated to helping organisations protect and enhance enterprise value

KEY FIGURES

- Established in 1982
- Revenues of over 1.5 billion US$, NYSE listed
- Over 4,200 employees, across 26 countries in 6 continents

AREAS OF WORK

- Economic and financial consulting
- Corporate finance / restructuring
- Legal, financial and economic assistance in the context of disputes and litigations
- Technology
- Strategic Communications

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3

FTI-CL Energy Expertise

FTI-CL Energy is a collaboration of energy experts from Compass Lexecon and FTI Consulting. Compass Lexecon is a wholly owned subsidiary of FTI Consulting.

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F.T.I CONSULTING COMPASS LEXECON ENERGY

EXPERTISE IN THE ENERGY SECTOR

- Strategy
- Public policy and regulation
- Conflict resolution
- Competition economics and State aids
- Mergers / acquisitions and transactions

SERVICES OFFERED

- Economic expertise in major commercial disputes
- Public policy, regulation or incentives design
- Fine tuning of corporate strategy scenarios
- Business model development
- Investment decisions support
- Energy markets modelling
- Investments in renewables and supply chain

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4

FTI-CL Energy selected clients

F.T.I CONSULTING COMPASS LEXECON
E N E R G Y

CLIENTS

- **Regulators**
- **Governments** on a national and European scale
- **Law firms**
- **Power companies**, including producers, transmission and distribution operators and end customers
- **Gas companies** all along the value chain
- **Equipment and technology suppliers**
- **Lenders and investors**
- **Trade associations**

Linklaters, Rte, RWE, EDF, gasNatural fenosa, E-CONTROL, ΔEH, entsoe, ENGIE, Friends of ETS, centrica, ofgem, GAZPROM, ENEDIS, Caisse des Dépôts, edp, direct energie, eurelectric, APG, nationalgrid, CER, GEG Gaz Electricité de Grenoble, Terna, MACQUARIE, QATARGAS, هيئة تنظيم الكهرباء - عمان AUTHORITY FOR ELECTRICITY REGULATION, OMAN, COMMISSION DE RÉGULATION DE L'ÉNERGIE, Enel, elia, endesa

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E N E R G Y

5

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E N E R G Y

Context

Principle of demand response

What is demand response?

- In power systems, electricity consumption and production should be balanced at all times
- In general, flexible generation is used to adjust production to consumption
- Alternatively, consumers can adjust their load to balance the system through "Demand Response" (DR). DR is a process through which:
  - **Consumers adjust the amount of electricity** they use at particular times of the day, e.g. peak period,
  - In response to a **signal** or in order to **bid on the electricity market**.
  - The signal could be a **price signal or through various communication and information channels** (remotely controlled device such as meters or boxes, phone call, emails, SMS etc.)
  - These adjustments can be **manual or automated** and can be operated on various devices in industrial, commercial or residential consumption sites.

Households: electric heating, water heating, Internet of things, electrical vehicles

Industries: diverse production machines, etc.

- Demand response can be used to balance generation and load in the power system, as generation
- Different forms of DR exist, and can have different properties, costs, etc.

7

Value of demand response

What are the values / services provided by demand response?

1. **Energy value**
   > Adapt load patterns to balance supply and demand
2. **Capacity value**
   > Avoid investment in peak generation to ensure adequacy
3. **Flexibility value**
   > Provide flexible/reliable reserves for TSOs to balance the power system
4. **Network value**
   > Balance supply and demand locally to avoid congestion / network invt

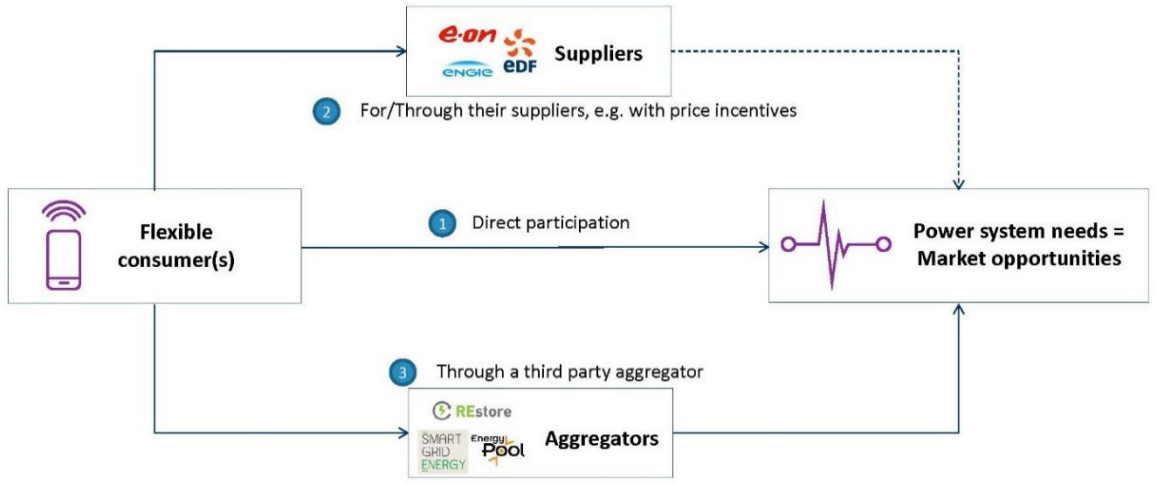
- Demand response has different sources of value
- The services they may provide depend on their characteristics (flexibility, location, reliability, potential frequency of activation etc.)

8

Market design for demand response

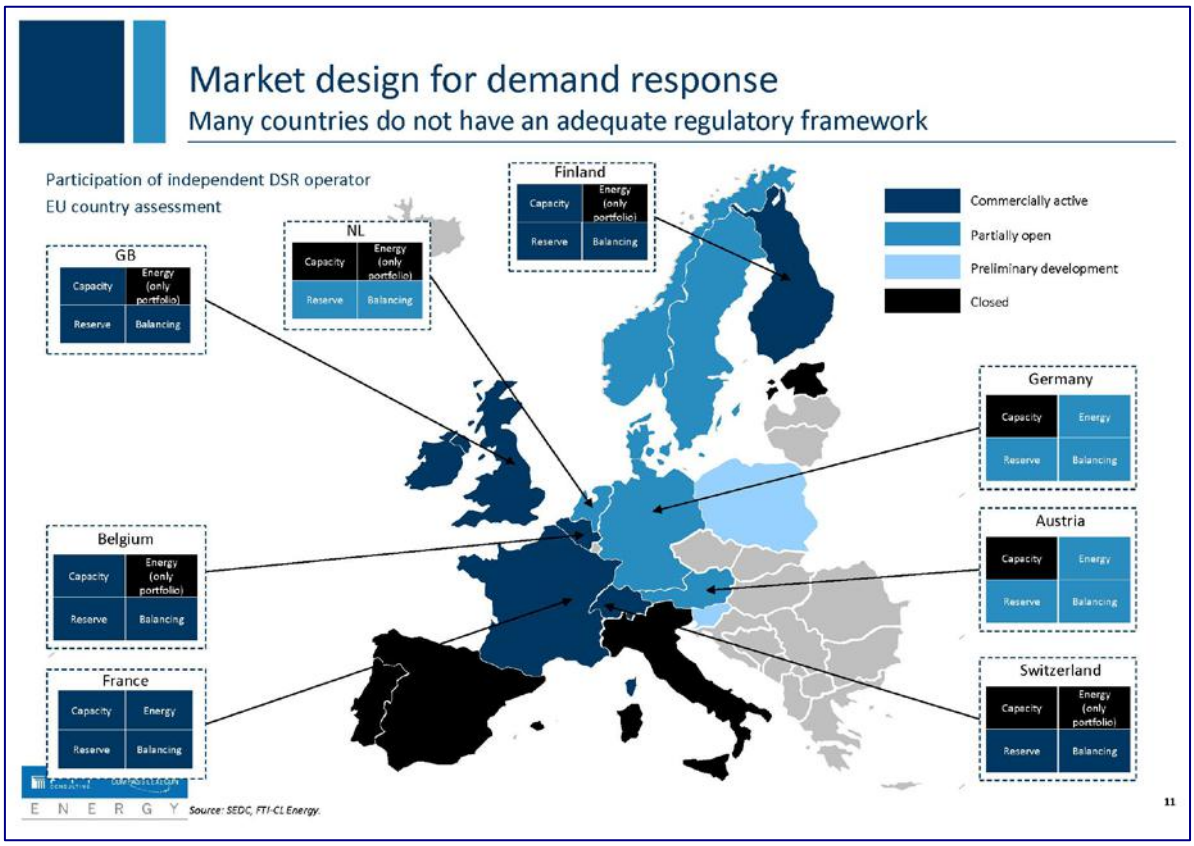
Market design for demand response

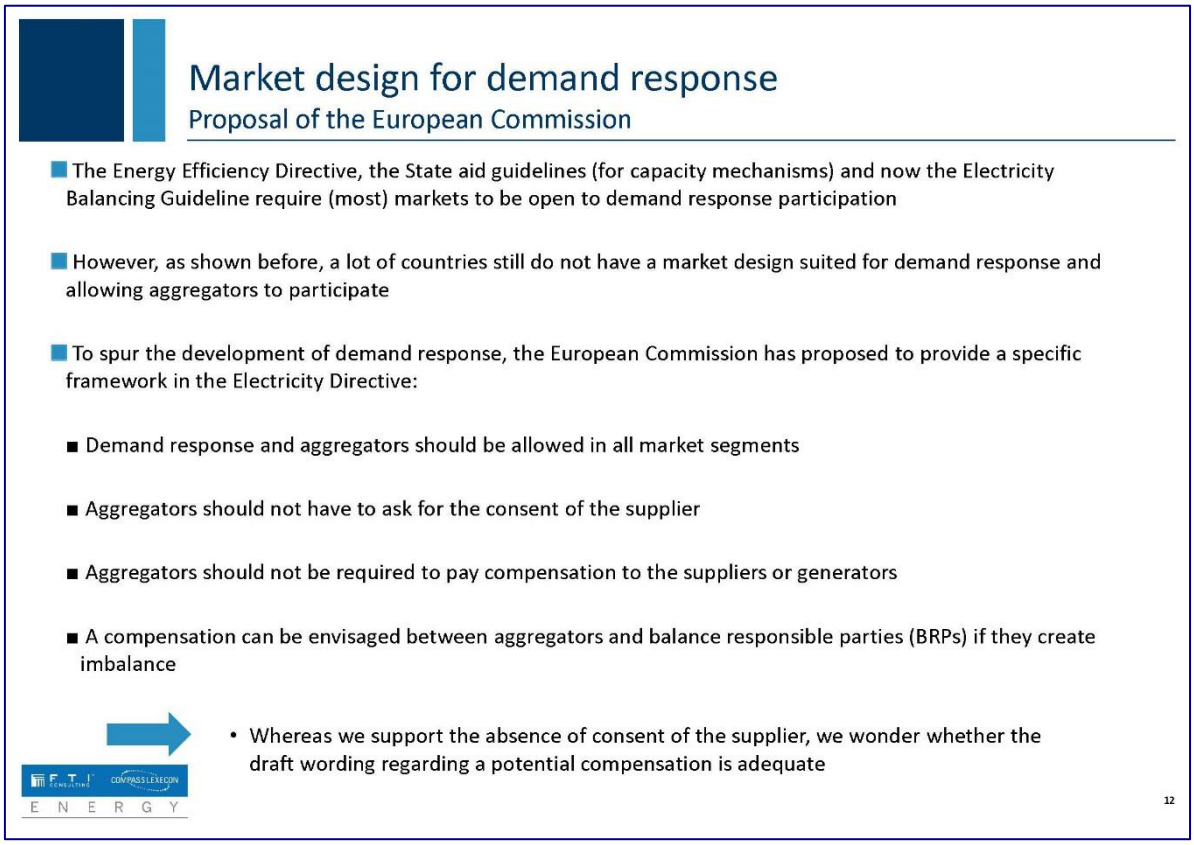
Approaches to value demand response



- Different channels are possible for consumers to value their flexibility
- Market design needs may differ

10


Market design for demand response
Many countries do not have an adequate regulatory framework
Participation of independent DSR operator
EU country assessment
Commercially active
Partially open
Preliminary development
Closed
Finland
NL
GB
Germany
Belgium
Austria
France
Switzerland
Capacity
Energy (only portfolio)
Energy
Reserve
Balancing
Source: SEDC, FTI-CL Energy.
11


Market design for demand response
Proposal of the European Commission
The Energy Efficiency Directive, the State aid guidelines (for capacity mechanisms) and now the Electricity Balancing Guideline require (most) markets to be open to demand response participation
However, as shown before, a lot of countries still do not have a market design suited for demand response and allowing aggregators to participate
To spur the development of demand response, the European Commission has proposed to provide a specific framework in the Electricity Directive:
Demand response and aggregators should be allowed in all market segments
Aggregators should not have to ask for the consent of the supplier
Aggregators should not be required to pay compensation to the suppliers or generators
A compensation can be envisaged between aggregators and balance responsible parties (BRPs) if they create imbalance
Whereas we support the absence of consent of the supplier, we wonder whether the draft wording regarding a potential compensation is adequate
12

Market design for demand response

Relation between aggregators and suppliers

- The French Competition Authority has analysed the case of demand response in the context of the French debate

- **The analysis of the French Competition Authority concludes that imposing to DSR operator to contract with the BRP/supplier of the site is problematic with regard to EU competition legislation:**
  - They argue that issuing such agreements would de facto create a **participation agreement market** in every perimeter, within which the **BRP would be in a monopoly position and thus in a dominant position** (as defined in Art.102 of the TFUE), whereas the BRP (often suppliers and integrated utilities) is **potentially in competition with DSR operators** in the balancing mechanism (and power market by extension)
  - **The European Court of Justice** considered several times that a state measure which would provide any private operator the right to deliver participation agreements to competitors to enter the market was likely to break the European community law, if this measure was not limited or controlled. In 2008 (ECJ, *MOTOE*, 1st July 2008 C-49/07), the court relied on Article 82 and 86 (now 102 and 106 TFEU) to express such a judgment.
  - More generally, it would violate the (stricter) **Service Directive** – *directive 2006/123/EC of the European parliament and of the council of 12 December 2006 on services in the internal market* (Article 14) – which forbids the Members States to condition the service activities participation to competitors' direct or indirect intervention.

- Nonetheless, some countries maintain this regime.

- The proposal of the Commission confirms the analysis of the French Competition Authority and addresses the underlying concerns

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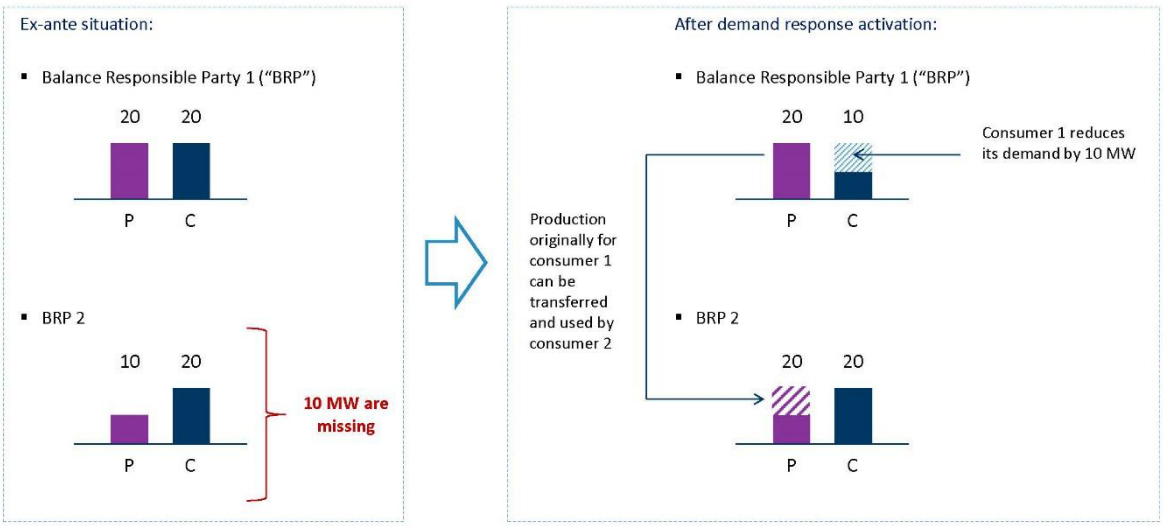
Market design for demand response

A transfer of energy from responsive consumers to others



- Generated energy is then "transferred" from responsive consumers to others
- If the BRP1 adapts to the changed load of its consumers, the system will remain unbalanced, which shows that it needs to "do as if" its consumers would have consumed
- Market design should address this transfer of energy and value between parties

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Market design for demand response

Market arrangements for the transfer of energy

- Activation of demand response induces transfer of energy between parties
- The aggregator uses the energy originally intended for a consumer ready to reduce its load to supply another consumer, who value electricity consumption more
  - The aggregator is an intermediary: somehow it "acquires" the electricity to the supplier (instead of the responsive consumers), which it can then sell either to another consumer, to the TSO or to market participants in the wholesale market
  - It should therefore pay for the energy it has acquired
- The supplier should be remunerated for the electricity provided:
  - The supplier of the responsive consumers should have sourced electricity for their consumers
  - It should maintain its sourcing for demand response to be effective
  - It should be paid for the electricity it has sourced for its consumers, even though they do not consume it due to DR activation

→

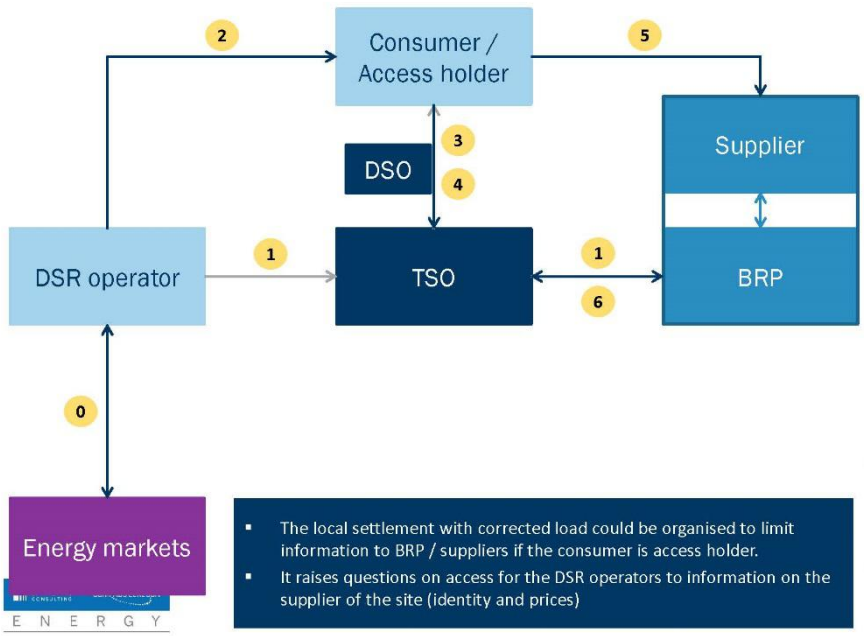
- The supplier should not be dis-incentivised to maintain its sourcing and should be paid for the energy provided
- Different arrangements are then possible to settle financially the transfer of energy

E N E R G Y

15

Market design for demand response

Transfer of energy through the consumer

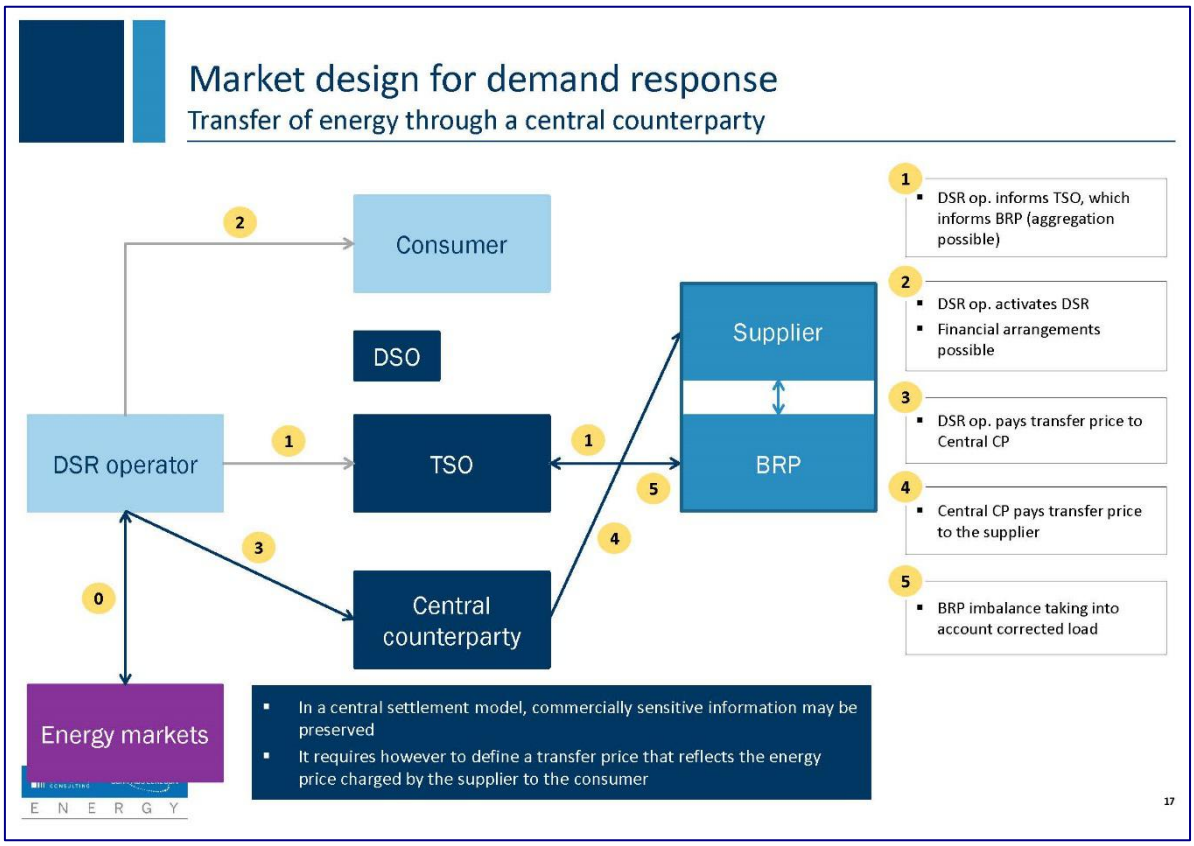


1. DSR op. informs TSO, which informs BRP (aggregation possible)
2. DSR op. activates DSR
   - DSR op. pays energy to Consumer
   - Other financial arrangements possible
3. SO informs Access Holder about corrected and not corrected load
4. Consumer pays SO taxes and network charges based on the actual load
5. Consumer pays energy to supplier based on the corrected load
6. BRP imbalance taking into account corrected load

- The local settlement with corrected load could be organised to limit information to BRP / suppliers if the consumer is access holder.
- It raises questions on access for the DSR operators to information on the supplier of the site (identity and prices)

E N E R G Y

16


Market design for demand response
Transfer of energy through a central counterparty
Consumer
DSO
Supplier
DSR operator
TSO
BRP
Central counterparty
Energy markets
0
1
2
3
4
5
1 DSR op. informs TSO, which informs BRP (aggregation possible)
2 DSR op. activates DSR
Financial arrangements possible
3 DSR op. pays transfer price to Central CP
4 Central CP pays transfer price to the supplier
5 BRP imbalance taking into account corrected load
In a central settlement model, commercially sensitive information may be preserved
It requires however to define a transfer price that reflects the energy price charged by the supplier to the consumer
17


Conclusions

Conclusions on market design for demand response
What is the way forward?

1 Demand response can bring significant value in the power system and should be allowed to participate in all market segments

- The Commission's proposal recognises that
- Demand response by aggregators should be allowed

2 Demand response operators (consumers, aggregators) should not have to request the supplier's consent, as it would breach competition law and hamper demand response development

- This was highlighted in 2012 by the French Competition Authority
- This is included in the Clean Energy Package

3 Demand response is a transfer of energy between parties. It is legitimate that the energy initially provided should be paid to the supplier (/BRP).

- The wording of the Commission's proposal should probably be adapted
- Today, most of the value for demand response is capacity-based (« insurance ») through capacity mechanisms / reserves or grid contracts: a pragmatic solution should be developed for the transfer of energy, to allow for a quick and not too costly implementation

4 Beyond these general principles, many aspects of the market design need to be adapted to demand response to effectively allow its development. TSOs and regulators should focus on that.

- Monitoring/verification procedures should be developed for demand response.
- Product design may also need to be adapted to fit to the need of TSOs / market participants while considering demand response specificities.

E N E R G Y

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E N E R G Y

Experts with Impact

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E N E R G Y
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Presentation by Mrs. Jessica Stromback

Current status and progress of Demand Response in the EU

Jessica Stromback
Chairman of Joule Assets and Chairman of the Smart Energy Demand Coalition
European Parliament
30th May 2017

SEDC
Smart Energy Demand Coalition

SEDC Membership

Executive Members

ade, ceced, EDF, enel, ENERNOC, entelios, GE, geo smarter energy, Honeywell, Gruppo innowatio, JOULE ASSETS, Landis+Gyr, REstore, Schneider Electric, SIEMENS, tiko, vaasaETT, VOLTALIS

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Two types of Demand Response

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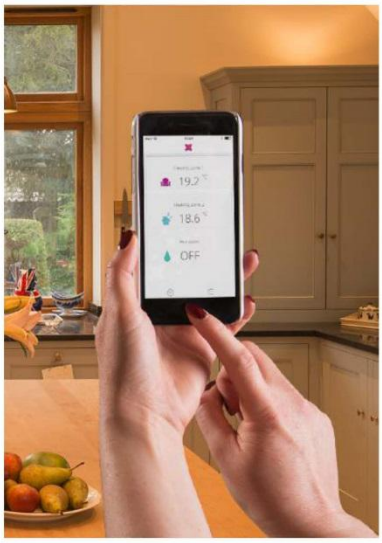
1) Implicit Demand-Side Flexibility

Consumer adjusts to variable market-price signals through

- personal choices
- automation

- ✓ uses power when it's cheapest
- ✓ saves money on consumer's bill
- ✓ saves hedging cost & supports system



Picture: geo

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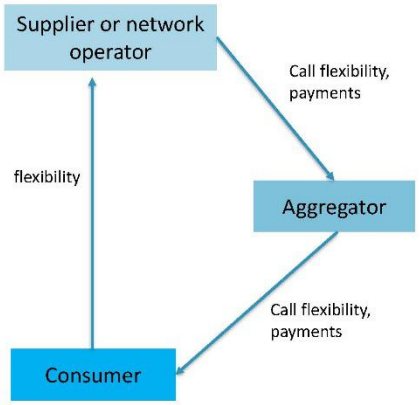
2) Explicit Demand-Side Flexibility

Consumer sells local flexibility via an aggregator

- ✓ Gains an income on committed flexibility
- ✓ Supports the system



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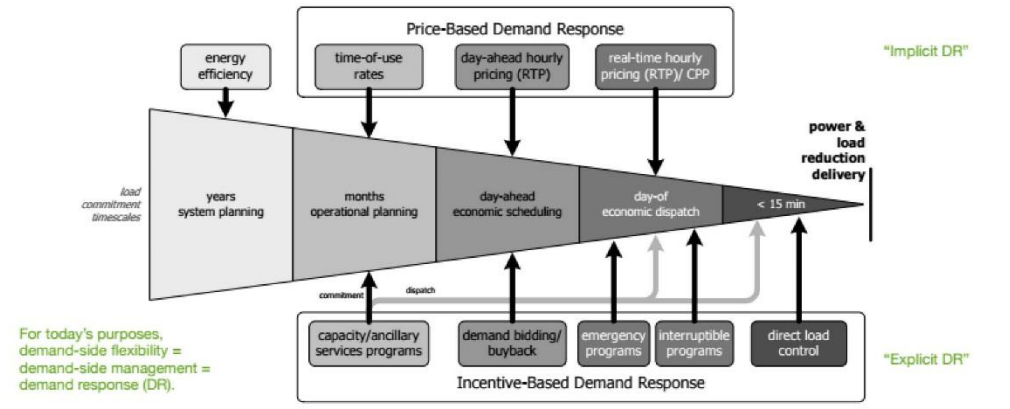
Implicit & Explicit Demand Response can go hand in hand



From US Department of Energy, Benefits of Demand Response in Electricity Markets and Recommendations for Achieving Them, Figure 2-3

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Real life examples of Demand Response in action - Commercial & Industrial

Vivaqua – Water Treatment

Sainsbury's – Supermarkets

ArcelorMittal – Steel Prod.

Pictures: REstore, Open Energi

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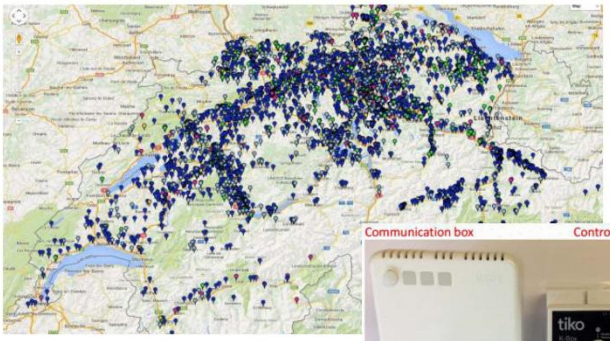
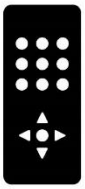
Real life examples of Demand Response in action - Residential

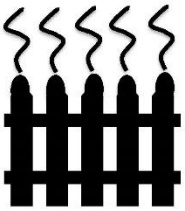


Credit: tiko

tiko: 10,000 customers in Switzerland



Finland: hourly electricity pricing & smart controls



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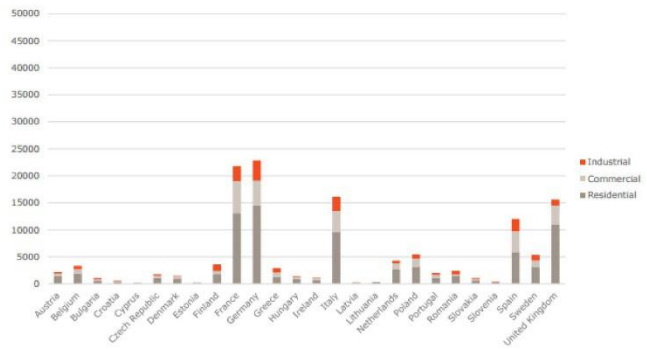
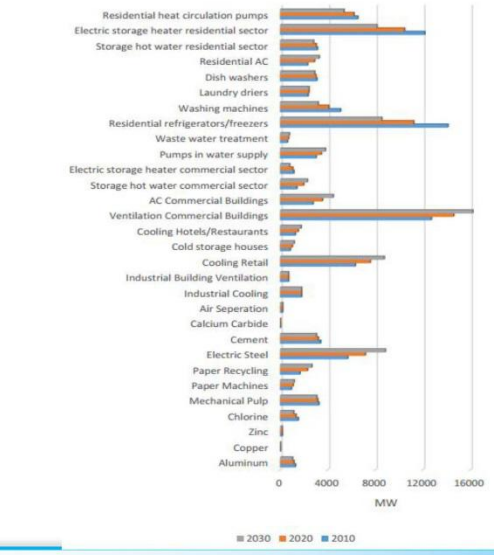
Demand Response potential

Figure 1: Theoretical demand response potential 2016 (in MW)



Source: Impact Assessment support Study on downstream flexibility, demand response and smart metering, COWI, 2016

Figure 2: Theoretical potential of demand response per appliance



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Mapping Demand Response in Europe

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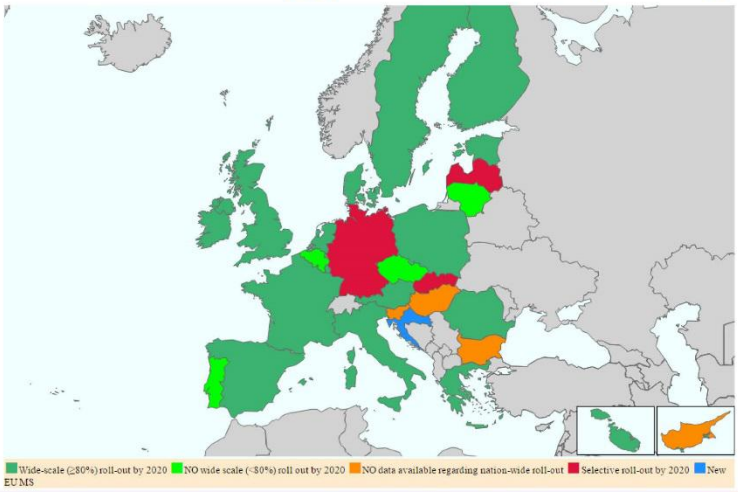
Access to a smart meter to support dynamic pricing

A smart meter should enable a real-time pricing contract

Advanced dynamic pricing contracts only available in Estonia & Finland

source: JRC



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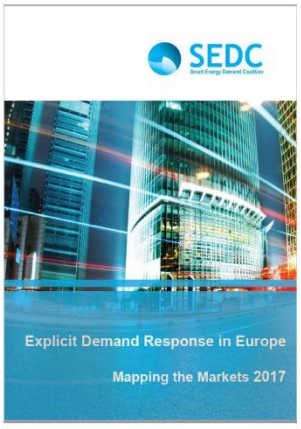
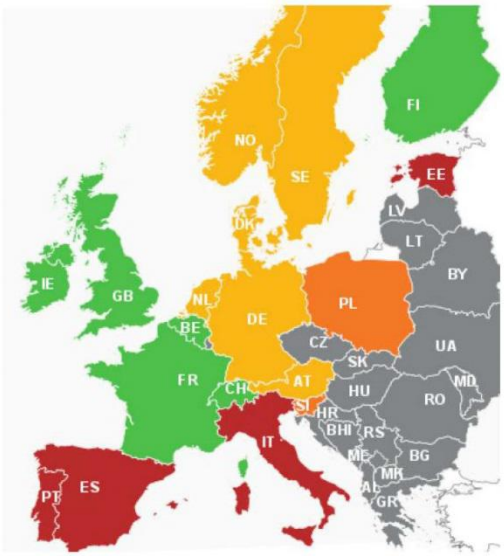
Explicit Demand Response 2017



- Commercially active
- Partial opening
- Preliminary development
- Closed
- Not assessed



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SEDC Policy Recommendations i

1) **Open** electricity markets for all solutions
- wholesale, retail, ancillary services, balancing, reserves, capacity products
- appropriate product definitions & gate closure times

2) Provide **fair market access** for all actors and service providers, prosumers and local communities
- free market access on an equal footing & consumer empowerment
- aggregator access to consumers without consent of retailer

3) Allow **effective price signals** at wholesale and retail level
- wholesale price caps removed – upward & downward price variability
- dynamic contracts & access to a smart meter

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SEDC Policy Recommendations ii

4) Facilitate relevant **data access** for all service providers
- consumers must access their own energy information
- they must be able to share it with third parties & be able to switch easily

5) Enable network operators to make optimal use of **decentralised** flexibility resources
- DSOs, and other network operators, to procure flexibility on the market, as alternative to investment in new capacity

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Chairman of Joule Assets and Smart Energy
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SEDC
Smart Energy Demand Coalition

Presentation by Mrs. Marie-Pierre Fauconnier

CEER
Council of European Energy Regulators

CEER: Fostering energy markets, empowering consumers

- Independent voice for 35 European energy regulators
- Promotes competitive, secure and sustainable markets for consumers
- Champions sound energy regulation with stakeholders, incl. policy-makers
- Supports NRAs and encourages best practices:
  - ▶ Training Academy
  - ▶ Workshops, e.g. international events on security of supply
  - ▶ Papers, reports, benchmarking

Putting consumers at the heart of energy policy: CEER-BEUC 2020 Vision

CEER
Council of European Energy Regulators

European Energy Market Context

Liberalised Markets
- Competition
- Consumer choice
- Demand-side and prosumer growth at DSO level

Renewables Growth
- Dispersed and Variable
- Low marginal cost
- Often small-scale at DSO level

New Technology
- Smart Meters
- Smart Grids
- Smart Heating
- Electric Vehicles
- Internet of Things
- Data Management
- Cybersecurity

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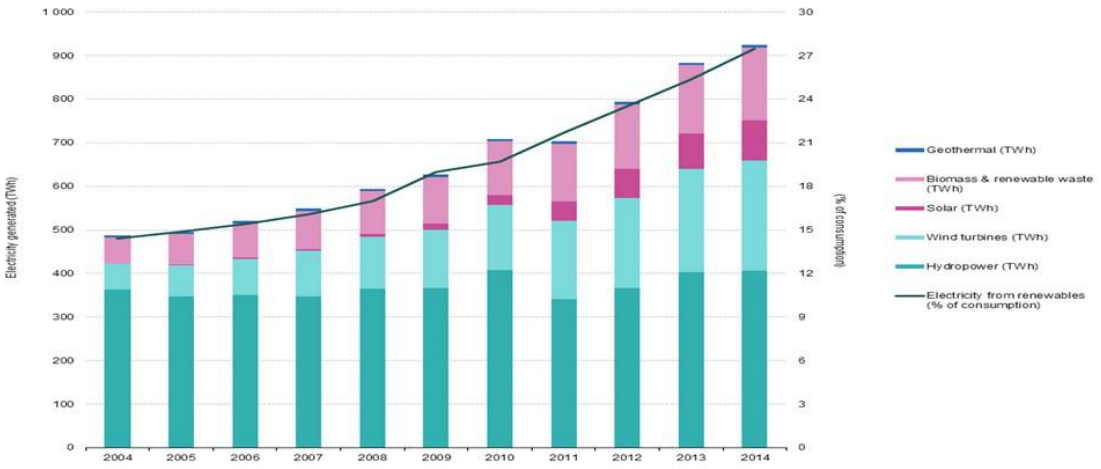
Growth of Renewables

- Renewable generation is now over 28% of European electricity demand
- Clean Energy Package to drive circa 50% RES by 2030
- More flexibility, including demand response, can help manage high RES



Source: Eurostat (online data codes: nrg_105a and tsdcc330)

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Flexibility - Demand Response

Flexibility

Markets
- Generation
- Arbitrage
- Demand

Networks
- Flexibility tools
- Infrastructure
- System operation
- TSO/DSO coordination

System Services
- Inertia
- Frequency support
- Voltage support

Retail
- **Smart Metering**
- **Time of Use tariffs**
- **Demand Response**
- **Internet of Things**
- **Electric Vehicles**

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Flexibility - Demand Response

- Demand-side response can improve market functioning and energy efficiency:
  - Better consumer engagement
  - Helps lower peak and overall demand
  - Helps lower bills and better for the environment
  - Helps manage more intermittent RES
- Typically assisted by smart meters
- Prosumers are welcome but fair cost allocation is needed:
  - Pay fair share of network and other system costs:
  - Avoid net metering

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Clean Energy Package

- Regulators' Overview Paper of 23 January broadly welcomed the Clean Energy package, highlighting issues for consideration

- Regulators publishing White Papers on specific Clean Energy proposals: RES and Wholesale, Networks and Consumer issues

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Council of European Energy Regulators

Flexibility - Demand Response

Regulators support the following Clean Energy proposals:

- The principle of addressing barriers to flexibility
- The possibility for consumers to bring their flexibility - individually or aggregated - to the market for valuing flexibility
- That requirements or participation of demand side response in markets should be on the basis of the needs of markets
- That all market participants (including independent aggregators) shall be subject to balance responsibility and shall be financially responsible for imbalances they cause

We see scope for improvement, and:

- Recommend a holistic approach, where all consumers have the opportunity to participate in all relevant markets for valuing flexibility, incl. through aggregation
- Recognise benefits of independent aggregation in less competitive retail markets
- MSs ensure that market access for aggregators is not foreclosed by suppliers and arrangements provide for payments for resold energy ('compensation')

CEER
Council of European Energy Regulators

Other Relevant CEER Positions[1]

- Fast supplier switching - aim for 24 hours by 2025!
- RES supports, where needed, should be designed efficiently
- Integrate RES into the market incl. balancing responsibility
- Enhance EU wholesale electricity markets:
  - Day-ahead market coupling, intra-day and balancing markets
  - Reward generator flexibility: real-time scarcity pricing reflecting electricity value
- Enhance DSO network planning and TSO/DSO coordination
- DSO should be a neutral market facilitator for competitive activities
- No one size fits all Code approach for network tariffs
- Prosumers should pay fair share of costs

[1] http://www.ceer.eu/portal/page/portal/EER_HOME/EER_PUBLICATIONS/CEER_PAPERS/White%20Papers


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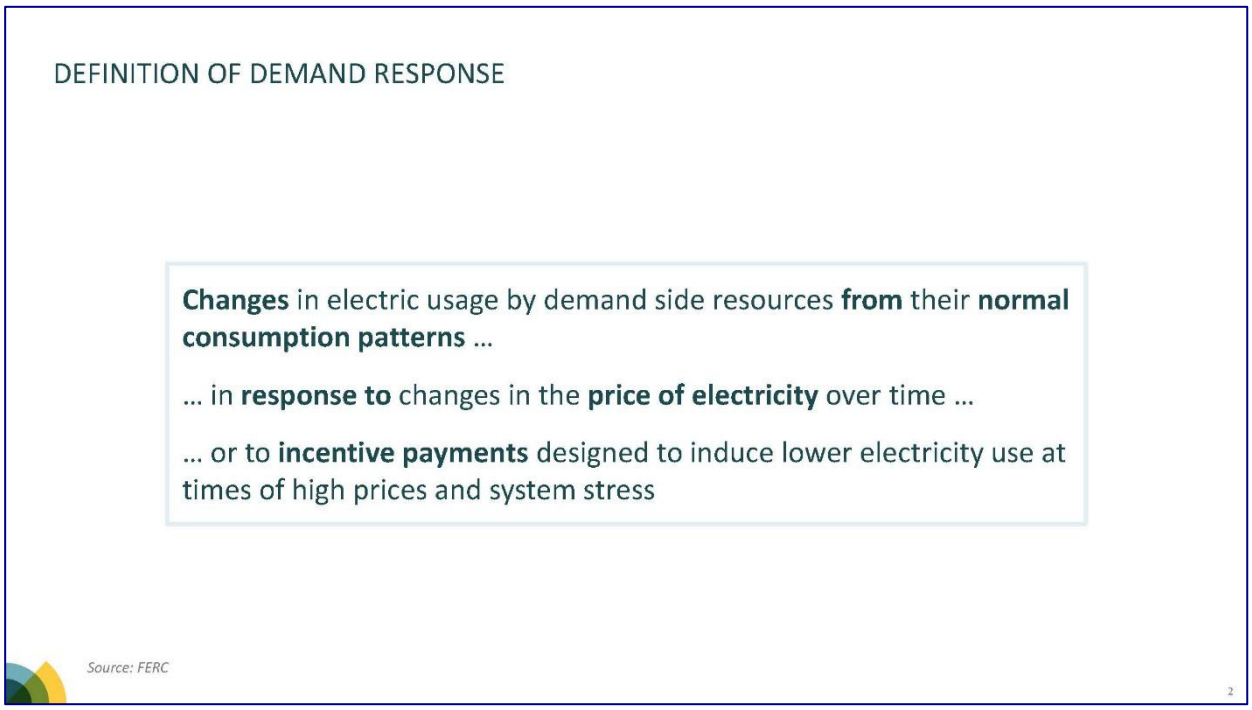
Presentation by Mrs. Kristine Fiksen



PURPOSE OF DEMAND RESPONSE:
TO IMPROVE THE FUNCTION OF THE POWER SYSTEM AND LOWER COSTS

Icon made by Freepik from www.flaticon.com

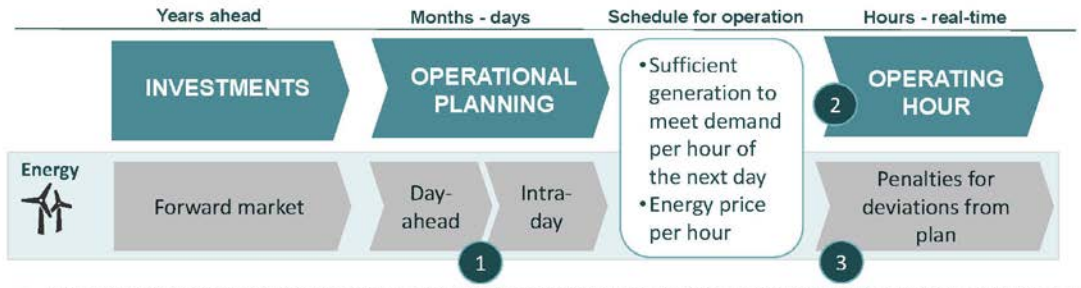
3

BEST PRACTICE IN ACTIVATING THE POWER CONSUMER IN THE ENERGY MARKETS

- Avoid trouble in the operating phase
  - Give incentives for the demand side to plan their consumption the day and hours before operation
  - ...since demand response in real-time is more expensive
  - Reward is not the only incentive: Deviation from plan results in a fee (imbalance costs)
- Markets are «big data» - take advantage of them
  - Allow the demand side in all markets
  - Allow markets to do its job to engage consumers – do not cap prices
  - This will reduce peak demand and increase demand response

4

THREE STEPS FOR DEMAND RESPONSE IN THE ENERGY MARKET – PLANNING IS CRUCIAL



1. **Large consumers and suppliers (on behalf of small consumers) will inform the market how much they plan to consume per hour the next day.** The plan (volume) may depend on the price – you then show your price sensitivity before the operating hour.
2. **Small consumers may respond to prices –** reduce their consumption in hours with high prices and increase in hours with low prices. Suppliers will learn from this behaviour and include it in their plan.
3. **Large consumers (and suppliers) will (normally) have to pay a fee if they deviate from schedule**

DEMAND REDUCTION IN PERIODS WITH HIGH MARKET PRICES
TWO EXAMPLES

- 16 % of the demand is price dependent
- For this hour the price ended at 158 EUR/MWh – cutting off 8.300 MW demand
- **This demand cut represents 12 % of peak load***

Price range [EUR/MWh]	14 December 2010		23 January 2015	
	MW	Per cent of total	MW	Per cent of total
-200 – 0	695	1.22 %	1 285	2.07 %
0 – 50	2 755	4.83 %	3 222	5.19 %
50 – 100	4 981	3.73 %	482	0.78 %
100 – 150	333	0.58 %	289	0.47 %
150 – 200	199	0.35 %	233	0.38 %
200 – 250	130	0.23 %	77	0.12 %
250 – 300	176	0.31 %	173	0.28 %
300 – 400	214	0.37 %	439	0.71 %
400 – 500	114	0.20 %	242	0.39 %
500 – 1 000	160	0.28 %	229	0.37 %
1 000 – 2 000	46	0.08 %	199	0.32 %
2 000 (price inflexible)	47 246	82.82 %	55 166	88.93 %

- 9 % of the demand is price dependent
- For this hour the price ended at 53 EUR/MWh – cutting off 3.200 MW demand
- **This demand cut represents 4.5 % of peak load***

Source: THEMA (2015): Capacity adequacy in the Nordic Electricity market. Based on bidding data from Nordpool Spot
** Peak load being 71.000 at Nordpool Spot*

SMART METERS, PRICE INCENTIVES, AVAILABLE MARKET AND CONSUMPTION DATA ARE NEEDED TO ENABLE DEMAND RESPONSE FROM SMALL CONSUMERS

- THE NORDIC MARKETS ARE GETTING THERE

	Norway	Sweden	Finland	Denmark
Smart meter roll-out	2019	2009	2015	2020
Metering time resolution	Technical: 15 min Use: Hourly	Hourly / monthly New meters: 15 min	Technical: 15 min Use: Hourly	Technical: 15 min Use: Hourly/ 15 min
Share of spot price contracts (2013)	32 %	25 %	8 %	5 %
Data hub	From 2017	From 2020/2021	From 2019	Yes
Capacity grid tariffs	Mandatory for large consumers, may also be for small consumers	No regulation, limited use	No regulation, limited use	No regulation, but TOU-tariff is recommended from 2016
Real time data availability	Mandatory	Mandatory for new meters	Mandatory	Mandatory
Market participation	Allowed on all markets, mandatory participation in energy markets. Providing demand response in the range of 3-10 % of peak load (2016 estimates)			
Aggregators	Market uptake is increasing slowly. Minimum volume and high costs are challenging. Balancing responsibility is mandatory to participate in markets.			

Source: THEMA (2015): Capacity adequacy in the Nordic Electricity market, THEMA (2014): Framework for demand response and micro generation in the Nordics, ACER/ CEER (2014): Anual report on the results of monitoring the internal electricity and gas markets in 2013

7

IF ALL PRICES ARE «RIGHT» CONFLICTING SIGNALS WILL NOT BE A PROBLEM – BUT IT WILL BE IF PRICES ARE NOT

Will load changes due to energy price challenge grid limits?

Grid tariffs: incentives for reduced peak when capacity is challenged – neutral if not

Will load changes due to grid tariffs challenge energy markets?

If there are bottlenecks in the grid, they will restrict the market

- Grid tariffs should only limit markets at times without sufficient grid capacity
- If the grid tariff is giving incentives at the right time and strength – conflicting signals are OK
- TSO-DSO coordination will be needed

8

SERVICE PROVIDERS HELP CONSUMERS BE ACTIVE

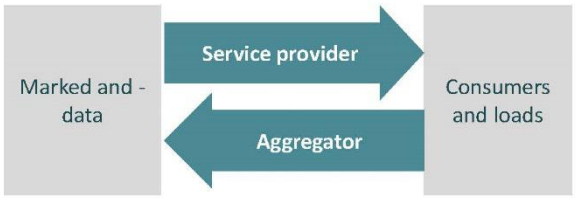
SMART METERS ARE ENABLERS, BUT NOT SUFFICIENT

Service providers: «Bringing the market to loads»

- Optimize loads based on marked information and information on electricity usage
- Predicable load changes – will be included i the planning phase

Aggregators: «Bringing loads to the market»

- Collect and handle loads – aggregate to a size that is interesting for the market
- Unpredictable load changes - > must have balancing responsibility

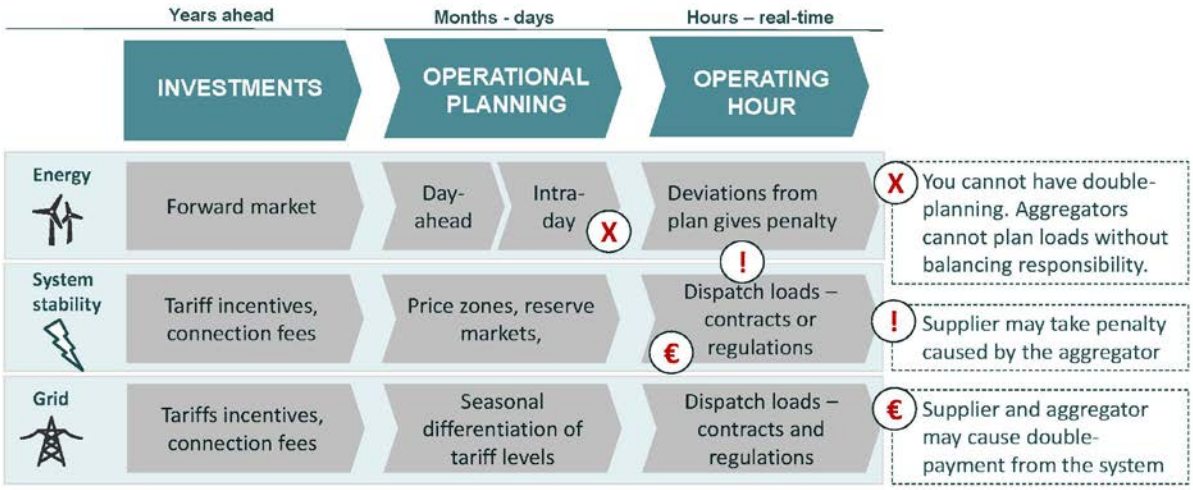


Source: THEMA Consulting Group

9

AGGREGATORS SHOULD BE BALANCING RESPONSIBLE

– TO MAXIMISE UTILISATION OF DEMAND RESPONSE AND TO AVOID MARKET DISTORTIONS



10

TAKE-AWAYS

- Planning is crucial: Preventing trouble in the operating hour is less risky and costly than fixing it beforehand through markets
  - But you still need to have enough resources to handle unforeseen events
- Efficient demand response: Allow (or oblige) the demand side to participate in all markets
  - Included aggregators (but on a level playing field included balancing responsibility)
- Right prices mitigate conflicting signals
  - Grid tariffs should (only) reflect the value of demand response for grid operation and planning
  - Markets are «big data» - make the most of them and do not cap prices
- Service providers and aggregators enable demand response, but play different roles
  - Aggregators bring loads to relevant markets (which require balancing responsibility)
  - Automation and service providers will help consumers respond to prices
- Enablers for demand response
  - Smart Meters are a prerequisite for demand response – to enable automation and verify response
  - Make data (prices, consumption) easily available for service providers and the consumer
  - Encourage spot-price contracts at the retail level

11

EXTRAS

12

SEVERAL MEASURES SPUR DEMAND RESPONSE IN THE NORDICS

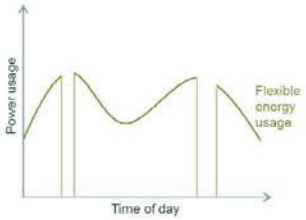
NOTE: GRID AND ENERGY ARE PRICED SEPARATELY ALSO FOR SMALL CONSUMERS

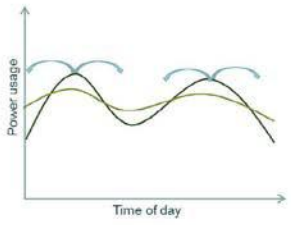
	Years ahead	Months - days	Hours – real-time
	INVESTMENTS	**OPERATIONAL PLANNING**	**OPERATING HOUR**
Energy • Sufficient energy • Acceptable prices	Forward market	Day-ahead / Intra-day	Penalties for deviations from plan
System stability • Avoid black-outs • Ensure quality and energy balance	Tariff incentives, connection fees	Price zones, reserve markets,	Dispatch loads – contracts or regulations
Grid issues: • Reduce costs • Increase quality	Tariffs incentives, connection fees	Seasonal differentiation of tariff levels	Dispatch loads – contracts and regulations

13

PRACTICAL EXAMPLES OF DEMAND RESPONSE – LOAD TYPES

Type of flexibility	*Type of load*	Example industry	Example buildings
Shut down energy usage	*Processes that may be **interrupted***	Stops in continuous processes with reduced production as a result	Electrical equipment like lightning, lifts or TVs
Shift in type of energy source	*Loads supported by **back-up** with alternative energy source*	Electrical heat boilers with alternative oil or gas boilers	Electrical heat boilers with alternative oil or gas boilers
Shift in timing of electricity usage	*Loads with **inertia***	Processes with cooling or heating	Heating, cooling or ventilation
	*Loads or processes with **storage or cache***	Grounded biomass in pulp and paper	**Batteries** and hot water tanks for tap water or heating. batteries
	*Processes or appliances with **excess capacity***	Greenhouses where lights may be shut down 4 hours per day	Dish washers and washing machines that does not run 24/7





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ASSESSMENT OF POLICY OPTIONS FOR AGGREGATORS

- The interference between the retailer (BRP) and the aggregator is handled in one of these manners:
  - Policy option 1: The suppliers (with BRP) integrate aggregated DR as part of their service offering and the suppler and aggregator operate in a single portifolio
  - Policy option 2: Aggregator and BRP are not operating in the same portfolio. Their activities are thus clearly split, either through standard contract procedures and agreements or by the aggregator taking on a second balance responsibility for activated loads
  - Policy option 3: The aggregator operates independently from balancing responsibility without any compensation to the BRP

DISTRIBUTIONAL EFFECTS OF POLICY OPTIONS BY ACTOR

Actor	Option 1	Option 2	Option 3
Generators	Will lose profit on intra marginal generation at peak load	Will lose profit on intra marginal generation at peak load	Will lose profit on intra marginal generation at peak load
Network operators	Reduced need for investment – no change in profits	Reduced need for investment – no change in profits	Reduced need for investment – no change in profits
Suppliers	Potentially, reduced risks as consumers reduce peak load demand when wholesale prices are high and exceeding the retail prices.	As Option 1 plus effect from more even wholesale prices. Both gains and losses.	As Option 2 though possible larger effects on wholesale prices.
BRP	No change	No change	Will lose on extra balancing costs (increased financial risk)
Aggregators	No change	Increased business opportunities	Increased business opportunities (more than in option 2)
Consumers	Reduced electricity bill	Reduced electricity bill (more than in option 1)	Reduced electricity bill

COSTS AND BENEFITS OF POLICY OPTIONS

	Effectiveness	Efficiency	Coherence
Option 1	+	+	++
Option 2	++	+++	+++
Option 3	+++	+	-

Note: + means positive effect of increasing magnitude

COWI, THEMA, Vito, ÅF, Ecofys (2016): Impact assessment study on downstream flexibility, price flexibility, demand response & smart metering

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MORE INFORMATION ON DEMAND RESPONSE IN THE NORDIC MAY BE FOUND AT

Input to a Nordic strategy for efficient use of demand response

- http://www.nordicenergy.org/publications/demand-response-in-the-nordic-electricity-market/

Capacity adequacy in the Nordic electricity market:

- http://www.nordicenergy.org/publications/capacity-adequacy-in-the-nordic-electricity-market/

Discussion of different arrangements for aggregation of demand response in the Nordic market:

- http://www.nordicenergyregulators.org/publications/publications-2016/

Regulatory framework for Demand Response and Micro Production in the Nordics:

- http://www.nordicenergyregulators.org/publications/publications-2015/

EU: Impact assessment study on downstream flexibility, price flexibility, demand response & smart metering

- https://ec.europa.eu/energy/en/studies?field_associated_topic_tid=42

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