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Demand Response status in EU Member States

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Abstract:
This report reviews the current status of European Member States' regulation supporting Demand Response and Aggregation in the wholesale, balancing and ancillary electricity markets, as stipulated in Article 15 of the Energy Efficiency Directive.
Demand Response is able to increase the system's adequacy and to substantially reduce the need for investment in peaking generation by shifting consumption away from times of high demand. It can act as a cost effective balancing resource for variable renewable generation. Adding stability to the system, it lowers the need for coal and gas fired spinning reserves – most running power plants burn fuel continuously in order to be ready to supply power at short notice. It furthermore decreases the need for local network investments, as it shifts consumption away from peak hours in regions with tight network capacity. Demand Response delivers these benefits by providing consumers – residential, commercial or industrial – with control signals and/or financial incentives to adjust their consumption at strategic times.

New insights on key success criteria for Demand Response which are in line with and benefit from, Europe's competitive market design are discussed in the report. A unique European Model begins to emerge. Positive developments in Member States have been evaluated and those who have looked to enable Demand Response are succeeding, despite continued barriers and remaining issues.

Demand Response status in EU Member States:

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Executive summary

The European Commission, Joint Research Centre (JRC) reviewed the progress of Member States toward opening markets for Demand Response as of the beginning of 2016, as part of its support to DG ENER in the frame of the Energy Efficiency Directive, to assess the transposition and implementation of specific Articles of the Energy Efficiency Directive (2012/27/EU) [1].

The Energy Efficiency Directive constitutes a significant step towards the development of Demand Response in Europe.

Art. 15. 4 requires Member States to:

- *"Ensure the removal of those incentives in transmission and distribution tariffs that are detrimental to the overall efficiency (including energy efficiency) of the generation, transmission, distribution and supply of electricity or those that might hamper participation of Demand Response, in balancing markets and ancillary services procurement".*
- *"Ensure that network operators are incentivised to improve efficiency in infrastructure design and operation, and, within the framework of Directive 2009/72/EC, that tariffs allow retailers to improve consumer participation in system efficiency, including Demand Response, depending on national circumstances".*

Art. 15.8 of the Directive establishes consumer access to energy markets, either individually or through aggregation. In detail the Article states:

- "*Member States shall ensure that national regulatory authorities* ***encourage*** *demand side resources, such as Demand Response, to participate alongside supply in wholesale and retail markets.*"
- *"Subject to technical constraints inherent in managing networks, Member States shall ensure that transmission system operators and distribution system operators, in meeting requirements for balancing and ancillary services, treat Demand Response providers, including aggregators, in a* ***non-discriminatory*** *manner****, on the basis of their technical capabilities****."*
- "*Member States shall promote access to and participation of Demand Response in balancing, reserves and other system services markets, inter alia by requiring national regulatory authorities […] in close cooperation with demand service providers and consumers,* ***to define technical modalities*** *for participation in these markets on the basis of the* ***technical requirements of these markets and the capabilities of Demand Response****. Such specifications shall include* ***the participation of aggregators****.*"

The 5th of June 2014 marked the end of the transposition period of the EED.

Article 15.8 therefore requires that regulators, TSOs and DSOs, adjust the technical modalities and requirements for market participation in line with participants capabilities and the needs of the market. These modalities fall into 3 general categories. Though they usually are developed in cycles, they are all required for healthy market growth.

[1] Directive 2012/27/EU, on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC, 25 October 2012.

Technical modalities which:

1. Authorise Demand Response, allowing consumer load to compete alongside generation assets in all markets;
2. Legalise and enable aggregation in all markets;
3. Adjust technical modalities in all markets, in line with consumer capabilities and market requirements.

Member State reviews

In reviewing the progress of Member States according to these three modalities, a uniquely European Model emerges. In successful cases, TSOs and regulators are using the deregulated and competitive market structures to empower providers and encourage market entry for consumers.

Therefore, while a significant portion of EU Member States have yet to begin their regulatory review with any seriousness, those who have looked to enable Demand Response are succeeding despite continued challenges. This bodes well for the future of the market, particularly when we consider the overcapacity of generation in some Member States. The fact that consumer load is still able to compete successfully and reliably under these conditions is positive.

However, further direction and clarity is required on the part of the Commission. A main finding of this report is that many national regulators see the process of opening markets to Demand Response, as complex and confusing. For example, two repeated questions were:

- Is it enough that Demand Response is not specifically forbidden?
- Is it enough that retailers can aggregate consumer load?

As one regulator from an inactive Member State remarked *'But Demand Response is not illegal here, and no one wants it anyway – why bother with all these little technical changes? They are a lot of work.'*

The status of Member States regulation concerning Demand Response can be divided into three groups.

First are those who have yet to seriously engage with Demand Response reforms. Obligatory provisions of the relevant EU Directives may have been transposed in name but not in fact. Therefore while Demand Response may be 'legal', the Member States have not for example, adjusted their regulatory structures to enable demand side resources to participate in the markets, begun the process of defining the role of the independent aggregator and DR service provider, or adjusted critical technical modalities. The result is that though Demand Response may be 'legal', there is no defined means for aggregators to offer the demand side resources, no way to measure or pay for the resources and no markets in which consumers or aggregators can sell the resources.

Regulators in Portugal, Spain, Italy, Croatia, the Czech Republic, Bulgaria, Slovakia, Hungary, the Baltics, Cyprus and Malta are in this group. However, Italy is aware of the issue and is undergoing a regulatory review, and the status may change within 2017-18. Greece has created one auction-based program for large consumers and intends to open the market further. Poland has created two programs, however these are not successful due to the low and controlled prices offered by the TSO.

The second group of Member States are in the process of enabling Demand Response through the retailer only. They limit aggregators to the role of service providers to retailers rather than independent parties providing independent offerings to consumers. This is an important choice – as this limits market offerings to those that are positive for the **retailers** in a given country – which may not be the same as those which would benefit the **consumer**. It also means the customer will not be offered a clear value for their flexibility - rather they will receive this bundled with their electricity bill. They either need to reject the entire package or accept. However it is difficult or impossible for them to know what they are rejecting/accepting as they will very rarely (if ever) have a fully transparent offer[2]. Germany, the Nordics, the Netherlands and, to a certain degree Austria, are in this group. Germany is undergoing a regulatory review and this situation may change in 2017-18. Austria has not defined the role of the aggregator but has made some significant progress in adjusting technical modalities.

The third group of Member States enables both Demand Response and independent aggregation. This includes Belgium, France, Ireland and the UK. Belgium and France have both defined the roles and responsibilities around independent aggregation. These markets have also made progress adjusting technical modalities and market entry requirements in order to facilitate consumer participation. Therefore though further work is required, the number of MW of demand side resources more than tripled between 2013 and 2015 (according to available data).

Conclusions and recommendations

Despite the barriers remaining today, in 2013 Europe was almost entirely shut to Demand Response and today consumers have the opportunity to participate in Demand Response programs in multiple Member States in accordance with the requirements of the EED. Europe's energy market is unique, and there is the opportunity to create unique solutions, combining competitive market structures with the decarbonisation agenda.

Three main sets of regulatory initiatives would significantly facilitate this development:

1. The roles and responsibilities of the independent aggregator should be defined: Regulation should ensure the consumer's right to freely choose their service provider. The standardised process between BRP/retailer and the aggregator is a significant enabler as it creates the framework by which aggregators can have a clear path to market. This framework includes[3]:

- *Volumes*: Standardised processes for assessment of the traded energy[4].

[2] This is not because the retailer will be looking to 'hide' value – rather the customer's engagement in DR impact's several aspects of the retailer's business model, their balancing costs, their company earnings from generation, network [retailer do not generate nor distribute] tariffs. The DR offering is therefore joined to the cost of the customer's electricity. It is not transparent and separated.

[3] A similar model was proposed by the Smart Grids Taskforce EG3

[4] i.e. the transfer of energy between the BRP's and the aggregator's balancing groups following a Demand Response dispatch.

- *Data Exchange:* A clear definition of what data needs to be provided to the BRP through the TSO, to ensure both the aggregator and the BRP can fulfil their obligations whilst **not** having to share commercially sensitive information.
- *Governance structure:* An appeals process and an appeals body, in case any issues need to be resolved.

A second important consumer enabler is to define and allow full Aggregation of Consumer Load: Qualification for participating in a market should be prequalified and measured at the aggregated pool level, rather than for each consumer individually. This is an important enabler as it allows the aggregated pool of consumer load to be treated as a single resource, maximising the group's joint potential. It also allows the aggregator to act as mediator for the consumer, protecting them from onerous and complex technical pre-qualification measures. It is questionable that some TSOs in Europe are capable of accepting pre-qualification of the pooled load and others are not. If 4-5 can do it the others can as well, and this critical barrier could be removed from all Member States.

Analysis of compensation of retailers for sourcing costs: The payment of sourcing costs are demanded by utilities and accepted by many aggregators. Sourcing cost refers to the energy the retailer bought, which the consumer does not consume because they are participating in Demand Response. There is widespread acknowledgement that the retailer loses income through their balance responsibilities during a Demand Response activation by an independent aggregator.[5] However the implementation of the sourcing cost payment mechanism in France the past 2 seasons, left less than €2,000 total for the participating aggregators and consumers. This indicates that particularly in markets where there is a significant energy component (such as wholesale markets) this mechanism may do significant damage to consumer's ability to earn from Demand Response. They will have to pay the majority of earnings back to their retailer. Careful review of this issue is therefore appropriate.

2) Market design should enable the participation of Demand Response and other distributed resources. European market design should enable the participation of Demand Response and other distributed resources such as Virtual Power Plants (VPP), to the same degree they now facilitate centralized generation units. Design elements include frequent auctions, short time durations (such as 15-30 minutes), small minimal bid sizes, and the acceptance of asymmetrical bids. There is now good knowledge of best practice concerning this market design and this should be implemented.

3) Technical modalities enabling Demand Response should be defined: Due to positive developments in multiple Member States, the technical modalities needed to enable consumer entry into a market are now known and tested. They should be standardised and replicated across Europe. These include registration, prequalification and risk assessment requirements, which are proportionate to the resource, appropriate tested baseline methodologies, and appropriate measurement and verification requirements.

No single Member State has succeeded in incorporating all the elements listed above in their markets. However these elements **complement each other** and bring about a **constructive unity**. They are in fact a **repeatable template** for realistic and positive enablers of Demand Response and Aggregation in Europe. Together, they use the competitive and dynamic deregulated market structures to enable consumer participation. What is now needed is for these solutions to be **unified**, **communicated** and **replicated across Member States**. The European Commission will play a critical role in this process.

Chapter 1. Introduction to Demand Response

This report reviews the current status of European Member States' regulation supporting Demand Response and Aggregation in the wholesale, balancing and ancillary electricity markets, as stipulated in Article 15 of the Energy Efficiency Directive.

Demand Response is able to increase the system's adequacy and to substantially reduce the need for investment in peaking generation by shifting consumption away from times of high demand. It can act as a cost effective balancing resource for variable renewable generation. Adding stability to the system, it lowers the need for coal and gas fired spinning reserves – most running power plants burn fuel continuously in order to be ready to supply power at short notice. It furthermore decreases the need for local network investments, as it shifts consumption away from peak hours in regions with tight network capacity. Demand Response delivers these benefits by providing consumers – residential, commercial[6] or industrial – with control signals and/or financial incentives to adjust their consumption at strategic times.

The Energy Efficiency Directive (2012/27/EU) [7] constitutes a significant step towards the development of Demand Response in Europe.

Art. 15. 4 requires Member States to:

- *"Ensure the removal of those incentives in transmission and distribution tariffs that are detrimental to the overall efficiency (including energy efficiency) of the generation, transmission, distribution and supply of electricity or those that might hamper participation of Demand Response, in balancing markets and ancillary services procurement".*
- *"Ensure that network operators are incentivised to improve efficiency in infrastructure design and operation, and, within the framework of Directive 2009/72/EC, that tariffs allow retailers to improve consumer participation in system efficiency, including Demand Response, depending on national circumstances".*

Art. 15.8 of the Directive establishes consumer access to energy markets, either individually or through aggregation. In detail the Article states:

- "*Member States shall ensure that national regulatory authorities* ***encourage*** *demand side resources, such as Demand Response, to participate alongside supply in wholesale and retail markets.*"
- *"Subject to technical constraints inherent in managing networks, Member States shall ensure that transmission system operators and distribution system operators, in meeting requirements for balancing and ancillary services, treat Demand Response providers, including aggregators, in a* ***non-discriminatory*** *manner****, on the basis of their technical capabilities****."*

[6] The term "commercial" is used here to mean all buildings and businesses which are not directly industrial or residential. In other words, municipal buildings, SMEs, businesses such as hotels, office spaces, etc.

[7] Directive 2012/27/EU, on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC, 25 October 2012.

- "*Member States shall promote access to and participation of Demand Response in balancing, reserves and other system services markets, inter alia by requiring national regulatory authorities […] in close cooperation with demand service providers and consumers,* ***to define technical modalities*** *for participation in these markets on the basis of the* ***technical requirements of these markets and the capabilities of Demand Response****. Such specifications shall include* ***the participation of aggregators****.*"

The 5th of June 2014 marked the end of the transposition period of the EED.

This report therefore provides a regulatory review of all 28 EU Member States and their application of Article 15 concerning Demand Response.

The requirements of Art 15 can be broken down into four areas:

1) Demand Response should be encouraged to participate alongside supply within the wholesale, balancing and ancillary services markets***;***
2) TSOs and DSOs must treat demand response providers, including aggregators, in a non-discriminatory manner and on the basis of their technical capabilities;
3) National regulatory authorities should define technical modalities for the participation in these markets on the basis of participants' capabilities;
4) These specifications should include enabling aggregators.

Member State regulation and practices have therefore been reviewed on the basis of these four criteria, 1. Is Demand Response encouraged to participate in the wholesale market, 2. Are balancing and ancillary services markets open, 3. Have TSOs, DSOs and regulators adjusted technical requirements in accordance with participants' capabilities - in order to allow them to participate, 4. Do these technical adjustments include enabling aggregators?

Demand response definition and types

Demand response is a tariff or programme established to incentivise changes in electric consumption patterns by end-use consumers in response to changes in the price of electricity over time, or to incentivise payments designed to induce lower electricity use at times of high market prices or when grid reliability is jeopardised.

Demand Response programmes can be categorised into two groups:

A) Explicit Demand Response is the type of DR referred to in Article 15. In this program, demand competes directly with supply in the wholesale, balancing and ancillary services markets through the services of aggregators or single large consumers. This is achieved through the control of aggregated changes in load **traded** in electricity markets, providing a comparable resource to generation, and receiving comparable prices.

Consumers receive **direct payments** to change their consumption upon request (i.e., consuming more or less). Consumers can earn from their flexibility in electricity consumption individually or by contracting with an aggregator. The latter can either be a third-party aggregator or the customer's retailer.

B) Implicit Demand Response (sometimes called "price-based") refers to consumers choosing to be exposed to *time-varying electricity prices* or *time-varying network tariffs* (or both) that partly reflect the value or cost of electricity and/or transportation in different time periods and react to those price differences depending on their own possibilities (no commitment). These prices are **always part of their supply contract**. Implicit DR does not therefore allow a consumer to participate alongside generation in a market.

It is important to note that neither form of Demand Response is a replacement for the other. Many customers participate in Explicit Demand Response through an aggregator, and at the same time, they also participate in an Implicit Demand Response programme, through more or less dynamic tariffs, such as a day/night tariff. The requirements and benefits of each are different and build on each other. The two are activated at different times and serve different purposes within the markets. They are also valued differently. While consumers will typically receive a **lower bill** by participating in a dynamic pricing programme, they will receive a **direct payment** for participating in an Explicit Demand Response programme.

Explicit Demand Response provides a valuable and reliable operational tool for system operators to adjust load to resolve operational issues. Implicit Demand Response, (dynamic pricing) does not allow a customer to participate in the balancing or ancillary services markets, or in most existing capacity markets. It will also not allow for regional demand-side services for TSOs and DSOs, and it does not provide the system as a whole with a dispatchable resource.

For this – it is critical that Demand Response activation is separated from the supply contract. This means that the offering is separated from the customer's electricity price.

On the other hand, Explicit Demand Response does not have the same market reach as a retailer-enabled dynamic pricing programme. **Both forms** are therefore required to allow all consumers to **fully participate** and benefit from their flexibility. However, the focus of this paper is on Explicit Demand Response as outlined in Article 15.8.

The role of the aggregator

The separation of the supply contract – or the customer's electricity price requires a new role – the role of the aggregator.

An aggregator is a service provider who operates – directly or indirectly – a set of demand facilities in order to sell pools of electric loads as single units in electricity markets. The service is provided

separately from any supply contract[8]. The aggregator – a service provider who may or may not also be a retailer of electricity – represents a new role within European electricity markets, but is well established in the USA, Australia, South Korea and Japan.

Most consumers do not have the means to trade directly into the energy markets because, for example, they are too small to manage the complexity. They require the services of an aggregator to help them participate. Aggregators pool many different loads of varying characteristics and provide backup for individual loads as part of the pooling activity, increasing the overall reliability and reducing risk for individual participants. They create one "pool" of aggregated controllable load, made up of many smaller consumer loads, and sell this as a **single resource**. These loads can include electric heating and cooling, fans, water boilers, grinders, smelters, water pumps, freezers, etc.

The Retailer Business Model and Demand Response

Aggregation services provided by an independent player or a retailer are a necessity for creating explicit DR programs. However, there are certain business model factors which can make it difficult for many retailers to provide these services. These can be broken into two categories, the retailer's potential conflict of interests concerning DR and the required changes in business model.

Demand Response is outside the expertise area of a retailer. It is a highly specialised service offering centred largely on knowledge of heating and cooling systems, industrial process, and marketing. To be successful, retailers must either outsource this expensive expertise or hire and train new staff - they will **not** have these resources in-house. Added to this, Demand Response **disturbs** their existing revenue streams from generation and balancing. For example, retailers who own generation assets, may earn an important part of their annual returns when prices are high. They also charge the large (and small) consumers for taking on their balancing risk – if they provide demand response they lower their income from generation, as well as the income from providing protection against balancing costs[9].

Some retailers do rollout Demand Response programs, (and do this well, EDF, E.ON, Dong Energy and Helsinki Energy being three examples). As in other competitive markets, such as Victoria, Australia and New York, there are also small independent retailers - who do not own generation assets - now emerging in Europe. A portion of these have made Demand Response a core part of their business model[10]. However, truly independent retailers, which are not owned by municipalities

[8] An exception: A retailer may aggregate and automate their consumer's load in order to manage their own balancing risk, along with generation assets. The consumer may therefore not receive a direct payment but only a lower electricity cost. That said their load will be used in the same way by the retailer as a generation asset.

[9] When a customer receives a flat electricity price- they do so because the retailer has taken on the balancing risk (the risk that wholesale prices may go higher than planned). This is a form of **insurance** for the customer. Just as an insurance company will not want their clients and competitors to know what they earn off of the insurance premiums, the retailer may not want consumers to know what they earn from taking on the balancing risk.

[10] The wholesale market structures (except in the Nordics), insurance requirements, balancing requirements, data requirements, registration requirements plus most of the technical barriers that face aggregators, also face small retailers providing DR. A retailer business is also more expensive to establish, an aggregation business requires €5-7 million, a retailer at least €15-€20 million and they will continue to have issues of scale. Today, they do not have a single group representing their interests in Brussels, likely due to their small size and the difficult business model. This is unfortunate as their needs would require support.

and do not own their own generation assets, serve a tiny proportion of European load (estimated at less than 2%).

To date, the activity of these retailers alone **has not created market momentum** or a positive cycle of investment in any competitive market globally. Without aggregators, the programs stay small and subordinate to generation assets. This is why the role of the independent aggregator is important.

The upfront costs, the risk of failure and the decrease in known and trusted revenue streams means that a retailer will not engage in Demand Response easily. Established retailers who do engage seriously in Demand Response do so because they face at least one of three challenges:

1. A total collapse of wholesale market price, removing the value of their generation portfolio. However, this involves destroying the market signal. (A situation faced by E.ON).
2. Ownership of an inflexible generation fleet, such as nuclear or wind, which drives up balancing costs and does not provide the retailer with a means of earning from exceptionally high prices. (A situation faced by EDF and Dong Energy)
3. Threats from outside independent aggregators, who create market momentum, a sense of competition over services and who raise consumer awareness.

When a retailer states that, dynamic tariffs, feedback programs or Demand Response programs provide no positive business model – this is probably accurate. There may be no viable business model **for the retailer**. What **may not** be accurate is that these same programs would create no benefit for industrial, commercial or residential consumers.

Clarifying the role of the independent aggregator is therefore an important enabler of consumer engagement and the healthy growth of market competition around Demand Response services in a Member State. An aggregator can only succeed when their customers succeed and benefit from Demand Response. Competition between participants, aggregators and retailers, therefore spurs healthy competition in Demand Response services for customers and creates substantial volumes of flexibility. For example, the latest PJM Market Activity Report on Demand Response (from August 2015) shows that 82% of Demand Response capacity in PJM comes from independent aggregators[11]. This trend has been increasing over the last few years. The shares are similarly high in other jurisdictions that have mature Demand Response markets, such as Western Australia, New Zealand or other US interconnections (e.g., New England and New York).

[11] PJM, 2015, Demand-Response Operation Market activity report August 2015; PJM calls aggregators Curtailment Service Providers (CSPs).

Chapter 2. Methodology

Below is an overview of the elements used to analyse the current status of Member State regulation concerning the application of Article 15.8.

The technical modalities required for Demand Response

Article 15.8 requires that regulators, TSOs and DSOs, adjust the technical modalities and requirements for market participation in line with participants capabilities and the needs of the market. These modalities fall into 3 general categories. Though they usually are developed in cycles, they are all required for healthy market growth.

Technical modalities which:

4. Authorise Demand Response, allowing consumer load to compete alongside generation assets in all markets;
5. Legalise and enable aggregation in all markets;
6. Adjust technical modalities in all markets, in line with consumer capabilities and market requirements.

This report has reviewed the following modalities within each Member State.

1. Authorization of demand-side resources to compete alongside supply
Authorisation is provided through a specific set of rules for each market, delineating how load participates. This condition is far from being fulfilled in the majority of EU Member States. In fact, in the majority of national electricity markets, demand-side resources are not allowed to participate, or they are allowed to participate in only one programme.

Delineation Elements:
Generators providing resources are **pre-qualified**, **measured** and **paid**. They also pay penalties if they do not supply according to contract. These same structures are required for Demand Response resources as well, if they are to participate alongside supply.

A. Prequalification, measurement and verification protocols must be *defined*.
They need to ensure reliable delivery of demand-side services in a manner that will still enable strong resource development. Several Member States claimed that they had legalised Demand Response but they had not developed any methods for pre-qualifying, measuring, communicating with or paying providers.

- **Fair and transparent baseline methodologies should be publicly available.** The volume of demand variation being sold into the market is assessed against a **baseline**. Volumes of demand-side flexibility are calculated as the difference between what the consumers normally consume (the baseline) and their actual measured consumption during the dispatch, measured using appropriate metering. If no baseline methodology is developed, consumers cannot be paid for what they provide.
- **Pre-qualification, measurement and verification processes should be defined and take place at the aggregated level.** It is important that the pre-qualification and communication protocols imposed are between the system operator and the **aggregator**. This saves the individual consumer from having to sustain the same administrative and measurement burden of a

centralised generator and is a **key element** of adjusting technical modalities in accordance with the capabilities of participants.

- **Payment criteria**, volumes and values should be transparent and based on open and fair competition. For similar services delivered to the system, meeting the requirements of the market, compensation for Demand Response payments should be commensurate with those services delivered by generation[12].
- **The market structures should reward and maximise flexibility and capacity in a manner that provides investment stability.** The market structures should value and pay for flexibility. This may entail availability payments, a guaranteed number of activations during the year or some other form of reliable payment. These should create investment stability to allow for the building of new resources designed to be available at short notice and for short periods of time. Ideally, market participants should be paid according to the Pay as Cleared (PAC) principle, to allow for the most competitive outcomes, as stated today within the European Network Codes.
- **Penalties for non-compliance should be defined, fair and should not favour one resource over the other.** Penalties needed to ensure reliability, so both supply-side and demand-side resources should be penalised for non-compliance. That said, penalty calculations for each may need to be differentiated depending on the market and the risk posed.

B. Enable Aggregators

In order to allow aggregators to participate, a Member State must define roles and responsibilities around aggregation providers. Several Member States have allowed aggregated load to be sold in the market but have not defined the roles and responsibilities of those selling them. This by default means that only retailers are able to provide these services to consumers. To enable independent aggregators to enter the market in a safe and scalable manner, it is critical that the role and responsibilities of these new entrants are clarified. In particular, it is important that the relationships between retailers, BRPs, and independent aggregators are clear, fair, and allow for fair competition.

Main principles and starting point of clarification of roles and responsibilities:[13]

First principle of competitive market design: To promote demand-side flexibility, a market design should guard consumer interests and create a level playing field for all competitors. Consumers that wish to generate revenue from their flexibility should be able to choose freely between all market options and available service providers. They should not be restricted to using a service provider that is tied to or approved of by their retailer.

For this to happen, the aggregation service provider must be able to operate independently from the consumer's BRP/retailer, which is potentially its competitor who may block their market entry[14].

[12] An added issue: In many European Member States today, generation resources have access to the markets at an embedded guaranteed cost through a longstanding bilateral agreement with the TSO or retailer. This can result in suppressing the price for new entrants both retailers and aggregators.

[13] The Smart Grids Taskforce, EG3 has also developed a similar model.

[14] The French competition authority, in its opinion 13-A-19, declares that the prior agreement to be given by a BRP for the participation on a market by an aggregator was not compliant with article 14.6 of the directive "Services" 2006.123/EC (12 December 2006). This article prohibits *"the direct or indirect involvement of competing operators, including within*

Therefore, standardised frameworks and processes should be put in place to enable the smooth functioning of the market and at the same time protect the customer-aggregator relationship. Below is a short overview of the structure of this standardised process between the consumer's BRP and the independent aggregator.

Content of the standardised framework: There are four elements to be defined through a standardised framework to allow the market to function reliably while allowing consumers to choose their aggregation service provider. Standardisation sets out "the rules of play":

- *Volumes*: Standardised processes for assessment of the traded energy between the BRP and the aggregator[15].
- *Compensation*: The retailers' BRP is required to buy, or source, electricity in advance in order to maintain balance. When Demand Response activation takes place, they may lose this purchased energy, as the consumer will not consume as planned. This may not be significant in a balancing market but it will be in the wholesale markets. Some Member States such as France have decided that the aggregator should pay the BRP for this energy. Others are still looking for other solutions. However, **a solution is absolutely critical** to allow independent aggregation and it should be fair to both the retailer, who is fulfilling its required role, and the consumer or aggregator looking to enter a market. Any price formula should reflect as closely as possible the average sourcing costs of the energy transferred.
- *Data exchange:* A clear definition of what data needs to be exchanged between BRP, aggregator and TSO to ensure all can fulfil their obligations whilst not having to share commercially sensitive information.
- *Governance structure:* An appeals process and an appeals body, in case any issues need to be resolved.

Different adjustment mechanisms to address the above situation have been trialled in a few EU member states and implemented in international markets. **It is important that settlement procedures are fair, standardised and well defined by the regulator and TSO in order to protect the financial interests of all parties**[16]

C. Adjust technical modalities in-line with participants' capabilities

The third set of criteria assesses whether the participation requirements (technical modalities) in the electricity markets enable access by a range of resources, including demand-side resources.

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consultative bodies, in the granting of authorisations or in the adoption of other decisions of the competent authorities, with the exception of professional bodies and associations or other organisations acting as the competent authority; this prohibition shall not concern the consultation of organisations, such as chambers of commerce or social partners, on matters other than individual applications for authorisation, or a consultation of the public at large". It is also important to note that if the consumer's retailer owns generation assets, the consumer's demand side flexibility is also a competitor to the retailer's supply side generation.

[15] Transfer of energy between the BRP's and the aggregator's balancing groups following a Demand Response dispatch.

While genuine system constraints and security concerns must be respected, many different product/programme participation requirements were historically designed around the specifics of generators by necessity. Today these narrow criteria are no longer justifiable because they block low-cost demand-side resources, and hence artificially inflate procurement costs. For example, a system's physical need for reserves typically requires the resource to be available for between ½-2 hours. However, the market participation requirements may state that load must be available for 12 to up to 16 hours. This fits the requirements of coal-fired generation, which operates most efficiently for extended periods of time at minimal incremental cost once the start-up costs have been incurred, but it does not reflect the actual system need. Markets should be designed in a granular manner, in order to enable the full range of resources to enter.

The technical modalities reviewed in this research reflect the elements, which constitute product design. They also capture the main barriers facing Demand Response in markets today:

- **Competitive framework:** the market becomes significantly more competitive when auctions are held often encouraging participation in a transparent manner. This also supports demand side resources as a consumer may be available one month or one week but not be able to guarantee availability for an entire year.
- **The required size of a bid:** bidding size requirement should be small in order to open markets to new entrants. A consumer or aggregator may need to provide up to 50 MW to participate in a market (a total barrier) – rather than the more realistic 3-5 MW or less.
- **Duration of the call:** Extended duration or availability requirements are a barrier for consumers and do not represent the technical requirements of markets. Therefore the length of time a participant should be required to adjust consumption should be as short as possible.
- **Frequency of activations/short recovery periods:** depending on the type of market, consumers require time to rest between activations.
- **Provide the option of asymmetric bidding:** few consumers can increase and decrease consumption equally. A requirement for symmetrical bids acts as a significant market barrier to consumer participation. In Member States where the TSO is willing to enable Demand Response, asymmetrical bids are allowed.

The technical modalities describing participation rules of the different products/programmes should allow a range of technologies to participate, taking into account their different characteristics, while ensuring that the system's needs are met. In a competitive market, the TSO and regulator have the responsibility to enable a range of resources to compete on an equal footing – not only selected forms of generation. Each Member State has individual market structures and therefore there is not a one-size-fits-all set of perfect market products.

As can be seen from the list above, enabling Demand Response is a significant development in any Member State's regulatory framework. It requires that the regulator and TSO decide to make consumer participation and market liquidity a priority. It also requires respect for providers and the willingness to engage with their representatives. It will take time to bring political theory in line with regulatory reality.

The results of the Member State analysis are provided in Chapter 2's Member State reports. Within the Conclusions a synopsis of the results is provided, including an overview of best practices and suggestions for next steps.

Clarification of market structures

The wholesale markets are by far the largest and (theoretically) most liquid markets in any given Member State. Here Retailers look to buy sufficient energy either from their own generators or from the market, to supply their customers. In order to maintain balance they should buy the same amount of energy for any given time period, as their customer's will consume.

This is part of their balance responsibility and each retailer will therefore have such a balance responsible party (BRP)[17]. Wholesale markets include futures markets but also intra-day and spot markets, where energy is bought and sold 15-60 minutes prior to the time of consumption. After this point there is 'gate closure'. The wholesale market activity is at an end and the TSO is responsible to maintain balance from the time of gate closure to the micro second prior to consumption. This is done through balancing markets and ancillary services.

Retailers may be required to pay the TSO for these services according to the amount that they were off in their balancing calculations. However the company's generators may also earn from providing balancing and ancillary services to the TSO. This mechanism is different in different Member States, but the principle remains the same.

ENTSO-E writes: 'Balancing refers to the situation after markets have closed (gate closure) in which a TSO acts to ensure that demand is equal to supply, in and near real time.

Efficient balancing markets ensure the security of supply at the least cost. An important aspect of balancing is the approach to procuring ancillary services. Ancillary services markets provide a range of capabilities 'which TSOs contract so that they can guarantee system security. These include black start capability (the ability to restart a grid following a blackout); frequency response (to maintain system frequency with automatic and very fast responses); fast reserve (which can provide additional energy when needed); the provision of reactive power and various other services.'

Explicit Demand Response is first established within the balancing and ancillary services markets. These provide the best investment security and prices. The types of services required by the TSO also fit a consumer's capabilities well. Therefore this paper pays close attention to these markets.

Information gathering

Information was collected through desk research of regulation and market results, and expert interviews with the respective National Regulatory Authorities (NRAs), TSOs, DSOs, retailers, aggregators, technology providers, consulting firms, research organisations and universities. The findings therefore reflect the experience of the players on the ground.

Information concerning the **technical modalities** for Austria, Belgium, Denmark, Finland, France, Germany, the UK, Ireland, Italy, the Netherlands, Poland, Spain and Sweden were sourced primarily from the SEDC's (Smart Energy Demand Coalition) Demand Response Map of 2015. This information and information for the other Member States was updated through expert interviews, the JRC survey, presentations given by market participants and complimentary desk research.

[17] An independent aggregator must also contract with a BRP in order to maintain their own balance.

Chapter 3. The status of Demand Response in 2014: a summary of the JRC report

The European Commission Joint Research Center (JRC) has been active in the preparation and monitoring of the Energy Efficiency Directive since 2008. A number of reports, workshops and trainings have been organised in support of the Directive. In this line, the JRC also contributed to the supervision and monitoring of Article 15 of the EED, in particular through workshops in 2010 and 2013, and reports, such as the report in 2014: **"Demand Response status in Member States: Mapping through real case experiences" (hereinafter referred to as "DR status report 2014"),** a JRC Technical Report, authored by Isabella Maschio, Paula Rey Garcia, and Paolo Bertoldi.

The DR status report 2014 drew a picture of the status of DR in the MS as of 2014 building on information collected at the workshop "Demand Response status in Member States: mapping through real case experiences" co-organised by DG ENER.C3 and DG.JRC.F7 in Brussels on 15 October 201318, the "Symposium" organised by RAP and SEDC in Brussels on 6 November 2013, and extended with further collection of open source information by the authors.

The report aimed at understanding the success and future scenario of Demand Response in Europe based on the analysis of a few representative case studies. The study focused on relevant barriers and achievements, and provided recommendations to further support the deployment of Demand Response.

The study looked at **14 European Member States**, some of which were identified as frontrunners, while others also had started the process of integrating DR in the electricity system and markets by 2014, even before the transposition deadline. The reviewed countries were: Austria, Belgium, Germany, Denmark, Finland, France, Ireland, Italy, the Netherlands, Sweden, United Kingdom, Poland, Spain and Italy

The recommendations covered three main areas:

- **Integrating more DR in national electricity markets at all levels, keeping in mind the ongoing construction of the IEM;**
- **Building a positive business case for all the actors involved in the DR value chain;**
- **Ensuring a smooth transition toward a new market scheme that fully integrates all DR potential.**

Integrating DR in national markets and in the IEM

At national level, few Member States clearly engaged in the process of a wide integration of Demand Response in the electricity markets as of 2014. Some markets were fully open, in others some DR products were allowed to participate.

To enhance this situation, the following recommendations were formulated in the report:

1. As it appears from the UK experience, an open and competitive market is a prerequisite to more integration of DR. Therefore **enforcing the full implementation of the Third Energy Package** is seen as a precondition.

[18] http://iet.jrc.ec.europa.eu/energyefficiency/workshop/workshop-demand-response-status-member-states-mapping-through-real-case-experiences

2. As of 2014, **none of the Member States had fully integrated DR in all national electricity markets**, including wholesale, balancing and ancillary services: either the regulation did not allow for it, or the regulation allowed DR to participate, but the roles and rules were not clearly defined, or the business case for DR was not sufficiently attractive. Recommendations for improvement included:

- adapting market products to DR: this could be carried out in two phases. In a first phase, specific DR products are developed, with requirements on size, duration and availability that are adapted to DR; in a second phase, products could be neutral and adapted to the generation as well as the demand side. Leverage on DR products that were used in past DR programmes also appears to be a valid option.
- adapting the regulation to DR products: this implies removing barriers, and eventually introducing quotas to (artificially) increase DR participation in a first phase.
- enabling and empowering the demand side: in order to enhance the active participation of final customers, the roll out of smart meters will be key for a diffuse participation of all sectors; additionally, clear and simple modalities for participation and a positive business case for end users are needed. Empowering intermediaries such as aggregators and service providers will also be a powerful means for reaching out a maximum number of customers. Finally, regulatory measures should be complemented with pilot project or information campaigns for the targeted groups.

3. While progressing toward the integration of DR in the national electricity markets, **the European dimension and the IEM should be taken into account**. This implies referring to ENTSO-E network codes when defining specific products (e.g. the network balancing codes for products in the balancing market). Furthermore, research into convergence trend of national regulations and network tariffs could benefit the DR integration process at EU level. Similarly, investigating common definitions for electricity market products, including DR products, could bring benefits toward integrating DR at European level.

A business case for DR

Very often the **unclear definition of roles and rules and of a concrete business case** was perceived as obstacle to the wide involvement of DR in the market in 2014. The overall business community, and in particular private and public financing institutions, should join the DR community in outlining the economic benefits that DR can bring to the whole value chain.

To overcome the above, the following recommendations were spelt by the DR status report 2014:

1. More research is needed to define a business case that is positive for all the actors involved in the DR value chain, who should first of all be able to make independent decisions, including DR "providers", in the residential, commercial and industrial sector; DR beneficiaries, that need to be clearly identified, and intermediaries, such as aggregators, service providers, and others.

2. The business case shall be solid but flexible, as it may need to adapt to a rapidly evolving context where regulation, tariff schemes, other programmes incentivising RES or infrastructure expansion, could have an impact, in addition to expected or unexpected technological changes (smart meters roll out) and their consequences (data handling issues e.g.)

3. Transnational considerations should also be taken into account as the building of the IEM will imply more cross-border exchanges at all levels.

The approach to a new market design

The market (re)design that allows for accommodating all the flexibility potential of DR, needs to be planned with attention. Parties involved shall include NRAs, the DR community and it might also involve as suggested "an ad hoc technical entity". The whole process shall:

1. Ensure a wide participation of parties involved and stakeholders, include consultations and be transparent

2. Be based on a far-reaching forward-looking planning guaranteeing a regulatory stability that attracts financial partners and allows for long term planning of resources.

3. Adopt a pragmatic and gradual approach, based for example on pilot projects followed by a wider deployment. The selected approach should be adaptive and ready to change with the fast evolving economic, regulatory and technological environment. European energy systems are undergoing substantial adjustments, with for example ageing or nuclear plants being phased out, increased renewable energy plants, more distributed energy sources, self-producers, new actors like prosumers, EV or storage systems.

A two-phase approach could firstly encourage the participation of DR in all the markets, with dedicated products or quotas and secondly reach a product-neutral market, fully compatible with DR.

4. The design phase shall be coordinated with other programmes in order to reveal synergies, e.g. with energy infrastructure or RES support programmes, EE in all sectors.

5. A smooth integration of all resources, on the demand side as well as on the generation side, and at national as well as at European level should be the long term aim.

Findings of the DR status report 2014 in respect of Art. 15.4 and Art. 15.8 were summarised in Table 1 and Table 2 below.

Table 1. *Summary of MS implementation of Art 15.4[19] (Note: status of 2014)*

N: network T: transmission D: distribution HH: households I. industrial G: generation L: load	**Art 15 (4): Removal of incentives in T and D tariffs that are detrimental to efficiency of the system and DR** ***Network tariffs and regulation do not prevent shifting or reducing demand (must reflect reduction for EE and DR)***	**Art 15 (4): Removal of incentives that might hamper participation in balancing market and ancillary services provision**
Austria NRA: e.control; TSO: APG	Share of Network tariffs paid by: 20% Generation, 80% Load	DR is providing Balancing at Balancing group level Electricity Market Code fix strict prequalification requirements for participation of DR in balancing and reserve system. > APG is investigating into improved payments for negative activations which do not penalise demand side resources
Belgium NRA: CREG (autonomy is questioned); TSO: Elia	Share of Network tariffs: 9% generation, 91% load	TSO contract DR under a reserve programme (R1).
Germany NRA: Federal Network Agency (BNetzA) for larger utilities and Regional Regulatory Authorities for smaller utilities; TSO:	Share of Network tariffs: 100% load	> no penalties should be charged (such as extra grid fees) if a provider produces negative reserve.

[19] Sources used:

[1] SEDC, Demand Response in Europe Today and fulfilment of the Energy Efficiency Directive Art. 15.8 (in press)

[2] ENTSOE Overview of Transmission Tariffs in Europe: Synthesis 2013;

[3] ACER-CEER Annual Report on the Results of Monitoring the Internal Electricity and Natural Gas Markets in 2012

Denmark NRA: Danish Energy Regulatory Authority; TSO: Energinet.dk	Share of network tariffs: 4% generation, 96% load	Participation of (aggregated) DR is not clear on balancing markets. DR to compensate wind, DR on Elbas (balancing) ; BRP must sign agreement with TSO; Balancing regulation is generation-centric but not excluding DR Demand can be aggregated in a balancing group
Finland NRA: Energy Market Authority TSO: Fingrid	Share of network tariffs: 15% Generation, 85% load	(Aggregated) DR participates in Balancing market (Secondary and Tertiary reserve). Pre-qualification for Primary Reserve is too restrictive Ancillary service open to DR and aggregation
France NRA: CRE TSO: RTE	Share of network tariffs: 2% Generation, 98% load	Tertiary Reserve market: requires availability 24/7 (typical for generation, not adapted to DR) Ancillary services: Demand Side Replacement Reserves, Replacement Reserves and Frequency Restoration Reserves are open to DR and aggregated DR Aggregators cannot bid as one single block (combining loads) in the Balancing market, but separately yes
Ireland NRA: CER Commission for Energy Regulation; TSO: Eirgrid	Share of network tariffs: 25% Generation,75% load	Ancillary services not open to DR
Netherlands NRA: Dutch Office of Energy Regulation (Authority for Consumers and Markets); TSO: Tennet	Share of network tariffs: 0% Generation, 100% load	DR and aggregation allowed and active in balancing market: Secondary Reserve (Frequency Restoration Reserve) and Tertiary reserve (Replacement reserve in Intraday market). Complementary FRR (=Emergency power) contracted by TSO Tennet (rarely used)

Sweden NRA: Sweden Energy Agency ; TSO: Svenska Krafnet	Share of network tariffs: 25% Generation,75% load	DR aggregation is allowed, but cannot participate independently in the market. Aggregated DR present in Peak Load Reserve PLR only; non aggregated DR participates in Tertiary Reserve and in Regulating Power Market (limited). Requirement for Primary and Secondary reserve too tight for DR.
UK NRA: OFGEM ; TSO: National Grid	Share of network tariffs: TNUoS: 27% Generation,73% load BSUoS: 50% generation, 50 Load	
Poland NRA: URE - Energy Regulatory Office (ERO); TSO: PSE	Share of network tariffs: 0% Generation, 100% load	DR can participate only in Emergency Demand Side Reserve (EDSR) programme: BSP must sign contract with TSO (no need for contract with BRP); min bid 10 MW (barrier); barriers = measurements at individual level and baseline definition inadequate; payment is for availability and is not incentivising DR participation; penalties are not excessive
Spain NRA:CNE Comision Nacional de Energia ; TSO: REE	Share of network tariffs: 13% Generation, 87% load	DR has access only to Interruptible Load Programme. Does not have access to any other ancillary services
Italy NRA: AEEG TSO: Terna		Interruptible Load Programme run by TSO (only industrial loads) DR allowed in Ancillary Services (sheddable loads, 15 min), energy remuneration

Table 2. *Summary of MS implementation of Art 15.8[20] (Note: status of 2014)*

N: network T: transmission D: distribution HH: households I. industrial G: generation L: load	**Art 15 (8) - 1** **MS>NRA encourage *DR to participate in wholesale and retail markets***	**Art 15 (8) – 2** **TSO and DSO treat DR, including aggregators, in a non-discriminatory manner;**	**Art 15 (8) – 3** **MS promote participation of DR in balancing, reserves and services markets; TSO and DSO and Demand service providers and consumers define technical modalities for participation in markets**
Austria NRA: e.control; TSO: APG	DR is not participating in Spot Markets > new regulation (2014?) will allow (aggregated) DR in: day-ahead, intraday, capacity procurement	Aggregators not considered by regulation now. No different TSO treatment between final customer and distributor > 2014, new rules will: - allow aggregators to become BRP (with reasonable requirements); BSP will need to contract with BRP - ensure that high grid tariffs for demand are not applied on negative activation - in auctions, contracts will be allowed with third party (for risk transfer)	> 2014, technical modalities will be adapted to DR: -new auctions of short-term products, low competition but increasing volumes (and increasing balancing costs) - minimum bid size reduced from 10 to 5 MW and activation time from 16 to 4h. - capacity market - new monitoring rules will be adapted to DR aggregators
Belgium NRA: CREG (autonomy is questioned); TSO: Elia	DR contracted by TSO. No access to Spot Market.	No access for aggregators to the spot market (complex contracting with DSO/BRP) > new Bid Ladder platform (TSO) should	> new products will open to DR and aggregators the Primary Reserve (R1) and the Tertiary Reserve (R3), > However, no access for DR to Secondary Reserve (R2) and Spot Market > Some Reserve markets will be

[20] Sources used:

[1] SEDC, Demand Response in Europe Today and fulfilment of the Energy Efficiency Directive Art. 15.8 (in press)

[2] DG ENER-DG JRC, Workshop on Status of Demand Response in Member States, Brussels, 15.10.13 at http://iet.jrc.ec.europa.eu/energyefficiency/workshop/workshop-demand-response-status-member-states-mapping-through-real-case-experiences

[3] RAP-SEDC, Demand Response Symposium 2013, Meeting Europe's Decarbonization Objectives for 2030, Brussels, 06.11.13 at http://sedc-coalition.eu/events-2/

	> 2014, access to specific reserve market (R1). > Next step will be allowing aggregators to participate	allow more market players to bid for generation and demand as well. Simpler. Will give access for (diffused?) DR to Ancillary Services.	capped for DR
Germany NRA: Federal Network Agency (BNetzA) for larger utilities and Regional Regulatory Authorities for smaller utilities; TSO:	(Aggregated) DR allowed in the IntraDay market. Minimum bid for all reserve programmes reduced to 5 MW > regulation should reduce the availability period required in the reserve market from 12h. > prequalification requirements should be set at the aggregated level (rather than at individual) > long acceptance process from the TSO, could be reduced (standardization)	Aggregators can operate in balancing market in Germany; but barriers exist on the retail market (getting approval by the BRP and also signing contracts with Tso, DSO, BRP, retailer, consumer) No different treatment between final customer and distributor	DR and aggregated DR allowed in Balancing markets. Secondary reserve and Tertiary reserve: generation-oriented, barriers to DR. Interruptible Load programme: aggregation is considered, but minimum size is 50 MW (barrier). Reserves availability requirement is 12h (barrier). Prequalification requirement at consumer level (barrier). Baseline methods are not standardised, long process to measure (barrier). All programmes pay for capacity and energy.

Denmark NRA: Danish Energy Regulatory Authority; TSO: Energinet.dk	DR is allowed, on Day Ahead and Intra Day market. However, DR does not participate in Spot Market (although allowed) BSP cannot access the markets independently. > Products requirements could be revised > participation should be independent of BRP	no clear definition of roles and responsibilities of BSP and BRP No different TSO treatment between final customer and distributor	Aggregated DR is allowed, on Day Ahead and Intra Day market. On the balancing market, no clear definition of roles and responsibilities of BSP and BRP for DR. On the tertiary reserve market: DR participates, but not aggregators, as DR aggregator (BSP) should become a BRP or contract with a BRP (that can refuse) Tertiary reserve: minimum bid is too high (10MW) and manually activated On the Primary Reserve, some heat storage (electric boilers at district heating plants) participate in DK1, Primary reserve: requirements are too tight for DR (short delivery time and number of activations); Secondary Reserve: products are not adequate for DR (symmetrical bids are market barriers) in DK2, Primary Reserve requirements disqualify DR
Finland NRA: Energy Market Authority TSO: Fingrid	(Aggregated) DR participate in Spot Market Aggregator can provide service to retailer by pooling loads in the retailer's balancing group, with bilateral agreement with the retailer.	Contractual relationship aggregators-BRP problematic. Aggregators play as a pool of loads (not individual loads): enables all size to participate. Good cooperation although no fully clear distribution of roles and responsibilities BRP-BSP SEAM and Energia Kolmio are only 2aggregators in FIN	Ancillary service open to DR and aggregation: good participation in Frequency Control Reserve and in Strategic Reserves. Contract BRP-Fingrid must be signed to access balancing market, paying reasonable fees; or aggregator can provide service to retailer pooling loads in the retailer's balancing group. Some products are adequate (on Spot MArket, Balancing market and Frequency Control reserve programme) to DR and aggregation; on other programme (Primary reserve) not.
France NRA: CRE TSO: RTE	No DR on wholesale market, but pilot project can lead to	Different treatment between final customer and distributor:	Ancillary services: Limited participation because business case is not completely clear and

	opening Day Ahead market	- A DSO directly connected to the lowest voltage level of a transformer that belongs to the TSO can use the tariff of the highest voltage level of this transformer. - A DSO owning lines of the same voltage level as the lines of the TSO it is connected to benefits from a discount. - When the actual temperatures are very low compared to average temperatures, DSOs may benefit from a discount on their capacity overrun. Aggregators cannot bid as one single block (combining loads) in the Balancing market Aggregators: EnergyPool, Voltalis, Smart Grid Energy, Dalkia and more.	investments cannot be planned; DR must know in advance how much it will offer and markets pay for energy rather than for capacity Tertiary Reserve market: requires availability 24/7 (typical for generation, not adapted to DR) Legal difficulties between BRP-BSP (BSP can aggregate load from only one BRP area, and needs bilateral agreement with BRP), will be clarified with entry into force of new law. Consumers with curtailment clause in contract cannot participate to other DR programmes > 2014: (Aggregated) DR will have larger access to markets. Frequency Control Reserves and Frequency Restoration reserves will be open to (aggregated) DR in 2014; with bid size adapted to DR > capacity market open to generation and demand (2016).
Ireland NRA: CER Commission for Energy Regulation; TSO: Eirgrid	Spot Market is open to DR: Demand Side Unit (DSU) must fulfil requirements DR programme with Eirgrid was switched off in 2013 to incentivise participation of DR to Spot Market. Ancillary services closed to DR. 2 DR Schemes: Short Term Active Response and Powersave	Multiple loads can pool to fulfil requirements as aggregator Aggregators operate as service providers for Demand side gathered to fulfil DSU requirements; no need of authorization from retailer or BRP. DR treated as customer's unpredictable behaviour. Roles and responsibilities of BRP/BSP need to be defined (and risks and costs of all parties are mitigated and shared). Retailer is not charged for load curtailment, not	Ancillary services not open to DR. 2 DR schemes: STAR and Powersave (both only utilisation payment). DSU requirements can be problematic (size of capacity, ramp up and ramp down rates, min and max down time, min off time, response time). Large potential cut off. Multiple loads can pool to fulfil requirements as aggregator. Payment for availability not for utilisation > review open to allow DR in balancing market (Services being technology-neutral)

		required to plan in advance. 2 aggregators registered: Activation Energy and Dalkia (+ 4 in application)	
Netherlands NRA: Dutch Office of Energy Regulation (Authority for Consumers and Markets); TSO: Tennet	Aggregators active in Day Ahead and Intraday	Aggregators active in Day Ahead, Intraday and Balancing markets (Secondary and Tertiary Reserve). Offer services to BRP to balance portfolios. Can act as BSP and optimize imbalances through real time dispatch. 4 aggregators: Powerhouse, Agro energy, Energie Data Maarschappij, NL Noodvermorgenpool.	In Secondary Reserve, min bid is 4 MW (favourable to DR) max duration set in bid (generally 10 min to 5 h). In contracted FRR 10 MW min (barrier)
Sweden NRA: Sweden Energy Agency ; TSO: Svenska Krafnet		In order to participate in the balancing market, aggregators can: become a BRP or contract with BRP (BRP can refuse). Not independent (barrier)	In Ancillary Services, product requirements for Primary and Secondary Reserve are too tight for DR. Tertiary Reserve has high minimum bid (10 MW and 5 MW). Low prices and availability payments + hydro power dominating ancillary services. Balancing Markets: measurement and verification mechanisms not sufficiently defined.
UK NRA: OFGEM ; TSO: National Grid	Triad system penalising consumption in peaks; 3 triad periods in the year when consumers can earn money by reducing consumption (or generating their own)	Aggregator does not require permission of retailer to access customer; no limitation in area. For the BRP: no obligation of maintaining consumption profile,.5 DNOs are running trials. > Rules will be needed for management of	Ancillary services open to DR: Short Term Operating Reserve (STOR) no longer for DR, availability requirement 24/7 is a barrier; Firm Frequency Response and Frequency Control Demand Management: limited DR. Fast Reserves programme require 50 MW min bid and 2 min response time (barrier). Mandatory

		relationship BRP/BSP. 20 (active?) aggregators listed on Ofgem website	Frequency response and non-tendered Fast reserve not open to DR. > Capacity market in 2016; rules under definition: no plans for DR, rules delayed for 2 years, no limit on call and call frequency (barrier), very high penalties (twice the revenues); Frequency Response (FFR, FCDM) require 2-10 sec (barrier). Fast Reserve require IT system adapted to DR (high cost for aggregator)
Poland NRA: URE - Energy Regulatory Office (ERO); TSO: PSE	> retailers plan to use DR to correct purchasing errors (Intraday trading is limited)	There is no differentiation from the TSO between final consumers and distributors but between different Points of Delivery (PoD). Aggregation is legal. But aggregator must be retailer (not independent).	> Balancing market will be open to DR with new rules by Energy Regulatory Authority and TSO (PSE); min bid 1 MW and requirements compatible with DR. Pull of loads (with no requirement)as an aggregate)
Spain NRA:CNE Comision Nacional de Energia ; TSO: REE	DR cannot access wholesale and retail market	Aggregation is allowed. No definition of roles and rules for BRP-TSO. No different TSO treatment between final customer and distributor	DR has access to Interruptible Load programme only: 150 participants, availability payment, attractive (large customers participate), no utilization payment, minimum size (5MW in peak) > proposal to open balancing market to DR (2104-2015) and new scheme for emergency power > could become auction system led by REE (TSO).
Italy NRA: AEEG TSO: Terna	DR can access the day ahead and intraday market	Smart meters rolled out but business case for aggregation (and aggregators) not clear	DR in the form of Interruptible Load programme

Chapter 4. EED Art. 15 and MS implementation according to NEEAPs

In order to accelerate the pace towards the full deployment of the Demand Response's potential, the recent Energy Efficiency Directive (EED) 2012/27/EU, include specific provision and significant actions in support to Demand Response.

Art. 15.1 requires that technical or contractual modalities, in particular network tariffs and regulations are adapted or changed if necessary in order to allow energy efficiency measures and services to be implemented: this implicitly allows the development of Demand Response participation in the energy market (without affecting the security of the system).

Network tariffs and dynamic pricing (Annex XI) can be considered to give clear market signals.

Art. 15.4 requires that network tariffs and regulation do not prevent TSOs, DSOs or energy retailers, from offering measures to shift demand from peak to off-peak or measures inducing customers to reduce demand. Moreover, network tariffs must reflect the reductions in network costs brought by Demand Response

Art. 15.8 contains dedicated provisions for effective relationships between different stakeholders, allowing for the engagement of the various actors including Demand Response alongside supply in wholesale and retail markets. In meeting requirements for balancing and ancillary services, TSOs and DSOs must treat Demand Response providers, including aggregators, in a non-discriminatory way: Member States engage in the definition of technical modalities to promote access and participation of Demand Response in balancing, reserve and other system services markets. By promoting dialogue and coordination between the parties, National Regulatory Authorities should also guarantee that clear technical rules and operational requirements (tendering, contractual arrangements, etc.) are disclosed, based on which DR can take part in the balancing market and in other system services.

Based on the information provided in the NEEAPs, this chapter will illustrate how the provisions on Demand Response dictated by Art. 15 of the EED (relevant for energy transformation, transmission, distribution & demand response) have been implemented in the EU28 Member States highlighting the main actions to support the full deployment of Demand Response.

Austria

An overview of the legal basis regarding the network tariffs for electricity and gas is given in the report however, Art. 15 is not well covered in the NEEAP. The Austrian Action Plan indicates there is no quantity discounts in the tariff system, i.e. customers drive no "benefit" for consuming more energy in order to receive "cheaper" network tariffs. Regarding facilitation and promotion of Demand Response, **all producers and consumers are entitled to take advantage of all supply-side and demand-side possibilities in electricity sector**. However, no specific measures are mentioned in the NEEAP.

Belgium -Brussels Capital Region

According to the NEEAP, **a study concerning Demand Response opportunities is being performed in Belgium and will be concluded in 2015.** EED relevant requirements concerning Demand Response seems to have been transposed in the regulations in place in the Brussels Capital Region. Energy network tariffs are Federal competence but are currently being moved to the regional level. Concerning this point, in the EEAP (Energy Efficiency Action Plan) it is pointed out that the previously mentioned project for a Regional Plan on Air, Climate and Energy (PACE) envisages the adoption of

progressive energy tariffs aiming at stimulating the efficient use of energy and investments on energy efficiency and renewable energies.

Belgium -Flanders

The Flemish NEEAP indicates that the authority to determine distribution system tariffs lies currently at federal level. For this reason, planned or adopted measures to ensure the removal of barriers to efficient generation, transmission, distribution as well as to Demand Response participation are not indicated. This same reason is used to justify the fact that planned or adopted measures concerning energy tariffs are not indicated. The NEEAP also mentions that system operators are obliged to provide an assessment of the energy efficiency potential of their gas and electricity infrastructures. Concerning measures specifically enabling Demand Response, a recently approved decree requiring VREG to provide incentives for participation of demand-side resources in the supply on the Flemish electricity and gas market is just mentioned in the NEEAP.

Belgium – Wallonia

The NEEAP mentions that energy tariffs are a Federal competence and that this competence is currently being moved to regional level. Measures are foreseen with respect to implementing the relevant requirements of the directive. Nevertheless, no details are communicated yet. The NEEAP also states that the Government can only issue guidelines concerning tariff incentives, improved efficiency through infrastructures and operation, improved customers participation in systems efficiency including Demand Response. The government seems to be willing to implement measures related to Demand Response probably also due to the fact that three nuclear plants are currently out of service in this region and there is hence a risk for a black-out. **Specific Demand Response measures addressing energy intensive industries should however be already in place, for example for industries which are requested to reduce their demand through electricity price signals**. Despite no specific information is provided in this respect, awareness raising campaigns seem to have been implemented on this subject. Some information is also provided in the NEEAP concerning a decree currently being modified to enable Demand Response. Concerning energy efficiency in network design and regulation, general points about the electricity infrastructure and the obligations of DSOs are reported in the NEEAP.

Bulgaria

Art. 15 is not well covered in the NEEAP. Only general information is provided, without description of the measures and targets.

Croatia

There is no special part for measures related to Energy Efficiency Criteria in Designing Network Tariffs and Regulations as well as for Facilitating and Stimulating Demand Response.

Cyprus

A number of measures which contribute towards a more energy efficient supply sector are mentioned in the Cypriot NEEAP. An upgrade of the operating voltage of overhead lines and transmission substations from 66 kV to 132 kV has led to a reduction of thermal losses during energy

transmission by 75%. According to the Transmission and Distribution Rules drawn-up by the CTSO[21], the capacity limit for connection to the medium voltage system is set at 20MW/MVA, beyond which connection to the high voltage system is mandatory. The CTSO is obliged by law to encourage the penetration of RES in the electricity grid and has also promoted/adopted measures with the aim to reduce the distance and/or quantity of the reactive power circulating in the system. Reduction of energy losses during energy transfer was also achieved as a result of restriction of the charge on transmission lines and power transformers with regard to their charge acceptance capacity.

Czech Republic

The Czech Republic is preparing a smart grid action plan that will include further measures to facilitate Demand Response. At the present time, the ripple control system is being used for many years now as a Demand Response measure. This ripple control system consists in a one-way communication system where customers, through a contract authorization, allow the control of specific appliances by the distribution system operator allowing this way a very effective load management. The ripple control is closely linked to the dual tariff system mentioned above. Presently, approximately 46% of the overall household electricity consumption and 31% of the overall small-business electricity consumption takes place in the ripple-controlled low tariff.

Denmark

Art. 15 is well covered in the NEEAP. **Many measures are included in the NEEAP tackling Demand Response.** In order to promote the use of efficient network and security of supply, **price differentiation** will be permitted from October 2015. **A wholesale model has been developed** where electricity trading companies will buy network services from the grid operators and will sell a packaged product 'supplied electricity' to consumers who will not be billed by the grid operators but by the electricity trading companies once a month for a total amount.[22] Electricity trading companies can set their own tariffs without approval from the authorities. Hence consumers can freely choose their supplier based on the products they offer.

Additionally **by 2020 grid operators will be obliged to install hourly reading remote electricity meters to all electricity end-users.**

Estonia

Art. 15 is only briefly covered in the Estonian NEEAP, and the extent of the provided information is limited. It is generally stated that art. 15 provisions (i.e. Demand Response, analysis of possibilities for increasing the energy efficiency of gas and electricity infrastructure) will be transposed in the national legislation through the **law that is under discussion (OEMA).**

Finland

The provisions of the Finnish Electricity Market Act from 2013 have been adjusted in 2014 in order to accommodate the EED principles so that tariffs cannot include incentives that can alter the overall efficiency of electricity generation, transmission, distribution and supply or incentives that can compromise the application of Demand Response. **The Finnish NEEAP also states that Finland has**

[21] Cyprus Transmission System Operator (CTSO)

[22] Electricity trading companies are not obliged to pass on the grid operators' tariffs to the consumers

already implemented clauses a) and c) of Annex XI of the EED regarding the shifting of the load from peak to off peak times and real time pricing. However it is not clear what was implemented to satisfy these criteria.

France

Art. 15 is not well covered in the NEEAP. There is only a small paragraph about smart grids. No information on the transposition of the mandatory elements of the EED are provided.

Germany

Art. 15 is not well covered in the NEEAP. It is generally stated that the legal and regulatory conditions in the country are not opposed to the use of load management measures and that controllable loads form part of the balancing energy market. None of the measures mentioned seem to target small consumers and are of little relevance to Demand Response.

Greece

For dynamic pricing, it is stated that smart meter installation, which is underway, is a pre-requisite, while it is possible to manage peak demand by providing multi-band tariff (day/night rates). With regard Art. 15 EED the NEEAP indicates that for dynamic pricing, smart meter installation which is underway, is a pre-requisite, while it is possible to manage peak demand by providing multi-band tariff (day/night rates).

Hungary

The currently used tariff systems are in line with Annex XI. The tariff system is cost-reflective of cost-savings at the demand side because – according to the NEEAP – the investment needs and amortisation rate reduces according to the reduction of demand. The tariff system cannot incentivise network operators. Based on the current rules, the network operators are not interested in increasing demand beyond 1 year timeframe. Time based tariff is hindered by the lack of intelligent meters, however a wide scale roll-out of these meters would probably not be cost effective. As a future measure, Hungary plans to support intelligent networks and thus distribute energy production from renewables.

Ireland

The NEEAP indicates that **Demand Side Management (DSM) has been a feature of the Irish and Northern Irish transmission systems for a number of decades. The types of DSM in operation at the moment are: Demand Side Units-DSU[23] (consists of one or more individual demand sites that can be dispatched by the TSO as if it was a generator),** Powersave (scheme encouraging large and medium sized customers to reduce their electricity demand on days when total system demand is close to available supply), Short Term Active Response (STAR) (electricity consumers are contracted to make their load available for short term interruptions). With the advent of smart meters and

[23] The focus of DSU aggregators is on large scale industrial customers. Dispatch instructions are issued by the Transmission System Operator (TSO) at an aggregate level and the DSU Aggregator then coordinates the reduction from the Individual Demand Sites.

home energy management systems towards 2020 the scope of DSUs to include smaller industrial and domestic customers will increase[24].

There are no elements of network tariffs which support the development of Demand Response services, although the Transmission Grid Code and Distribution Grid Code working parties are considering the issue.

Italy

The on-going implementation of policy measures for the elimination of progressive electricity tariffs for households is described in the NEEAP as a measure to remove tariff incentives that are detrimental to energy efficiency. This policy measure, however, could at most be considered as a measure promoting end-use energy efficiency. It is not a measure promoting efficient generation, transmission, distribution or supply of energy. The NEEAP makes also a general reference to energy tariffs established by taking into account end-users participation in the networks load during peak hours. These measures however could only be considered as measures promoting efficiency through infrastructure design and operation, as apparently assumed in the NEEAP. NEEAP parts concerning measures addressing energy transformation, transmission and distribution are probably the weakest parts of the Italian NEEAP. The Italian Authority for Electricity and Gas (AEEG) has a mandate to propose possible measures that can be implemented in these sectors. **Measures for the promotion of Demand Response do not seem to have been described in the NEEAP, either. Apparently, Italian policy makers do not yet have a clear picture about possible measures that can be implemented to enable Demand Response.** Also in this case, the AEEG has received a mandate to investigate how this aspect could be addressed.

Latvia

Art. 15 is not well covered in the Latvian NEEAP. It is just generally stated that, Network operators are incentivised to improve efficiency in infrastructure design and operation by means of a project named “Kurzeme Ring, 2nd Phase: 330 kV Transmission Line Grobiņa – Ventspils”, which is intended to strengthen the transmission grid in the western region of Latvia. Moreover, it is also planned to improve grid links to Europe’s energy backbone through active absorption of the Connecting Europe Facility.

Specific measures for the promotion of Demand Response are not mentioned in the NEEAP.

Lithuania

It is generally stated that the legal and regulatory conditions in the country are not opposed to the use of load management measures and that controllable loads form part of the balancing energy market.

The National Control Commission for Prices and Energy will lay down the technical modalities for Demand Response measures, including the consumer access to such measures and participation of providers of Demand Response measures in the electricity market.

Luxembourg

[24] A major program of smart meters technology and user trials, National Smart Metering Programme (NSMP), showed that a National rollout of Smart Meters could lead to reductions in overall electricity and gas consumption, as well as an 8.8% reduction in peak-time electricity consumption. The Commission Electricity Regulation is currently evaluating the development of time of use tariffs.

For the transposition of Art.15 and requirements of the EED in relation to EE in Energy transformation, transmission, distribution and Demand Response, **Luxemburg is currently undertaking amendments of the Law of 1st of August 2007 on the Organization of the Electricity market as well as the Law of 1st of August 2007 on Organization of the Gas market**. Both laws have been in legislative procedure since mid-2014. The Law on Organization of the Electricity market will enable the end users to participate on EE of the systems including through the use of Demand Response tariffs. **Demand response will be also introduced for wholesale and retail sectors.**

Malta

In terms of energy efficiency in the retail tariffs, a set of 'principles' which inter-alia deal with energy efficiency will apply to tariff proposals that Enemalta[25] submits for approval. Enemalta has no fixed roadmap for the adoption of a smart grid at the moment. **Shifting customers' electricity demand to off-peak has not been considered in detail as experience with dual tariff facility offered to industry showed no shift of industrial activities to off-peak hours.** Energy efficiency in Network Design and operation is currently pursued through on-going programmes such as a transformer de-rating programme to reduce copper and iron losses where it is found a lower rated transformer suffices, a load balancing program, an increase in the number of Low Tension feeders, a low voltage feeder load balancing programme and the replacement of corrosion prone aluminium lines by copper leads to avoid resistivity losses.

The Netherlands

The **Electricity and Gas Acts already promote network tariffs that are related to the most effective operation and quality of the electricity chain** and it is stated that no additional requirements are needed due to the lack of distinction between providers of balancing and ancillary services in the network tariffs. It is also stated that **dynamic electricity and network tariffs for Demand Responses is already implemented** and the electricity transmission tariffs depend on the voltage of the network to which the customer is connected as well as the capacity of the electricity connection.

Poland

In the Polish NEEAP, no measures regarding Energy transformation, transmission, distribution and Demand Response were mentioned.

Portugal

Art. 15 is not considered in the Portuguese NEEAP and there is no reference to the assessment to be realized regarding the energy efficiency potentials in the network and infrastructures nor in Demand Response.

Romania

Romanian NEEAPs provides an analysis of the electricity market structure, outlining the role played by the National Energy Regulator Agency in defining the tariffs and the regulation of the market. Concerning Demand Response measures, the Romanian NEEAP provides some information on the flexibility of the energy networks, however, mainly on the network side.

Slovenia

[25] Enemalta is the only licenced electricity supplier in the country. There is no case for tariffs for third party access to the distribution network, no possibility of switching suppliers, and no balancing or ancillary services procurement.

The introduction of intelligent metering is outlined as a key factor for the participation of consumers in network efficiency in the Slovenian NEEAP. Grants will be provided from OP EKP 2014–2020 funds for the promotion of the development of intelligent distribution networks by upgrading the existing electricity infrastructure (smart metering, ICT support for smart services, etc.). Under this measure, the introduction of remote metering by actual consumption with two-way digital communication between supplier and consumer is expected as well as the introduction of dynamic innovative tariffs. These are expected to be important for the facilitation and encouragement of Demand Response services.

Spain

The Spanish NEEAP reports that in the current regulations for the electricity sector, the government is responsible for establishing network remuneration methods, while the National Markets and Competition Commission is responsible for establishing a **methodology for the allocation of costs** of access tolls taking into account the remuneration of such activities. In regard to measures adopted or envisaged **to facilitate and promote Demand Response, specific provisions are included in the recently-enacted Law 24/2013 of 26 December 2013 of the Electricity Sector**[26] **and in the Royal Decree 216/2014 of 28 March 2014 which improves the participation of small consumers in system efficiency and Demand Response**[27]. With respect to large electricity consumers, the NEEAP generally indicates that measures have been taken with the approval of two orders (in 2013 and 2014) regulating competition mechanisms for the allocation of interruptibility demand management service.

Sweden

Art. 15 is not well tackled in the Swedish NEEAP. It is generally stated that the Swedish legislation does not contain any explicit prohibition of tariffs that have a detrimental impact on total efficiency and there is stated to be some doubt as to whether the Swedish regulations provide a direct incentive for network enterprises to make system services available to network users. Provisions regarding such an incentive may therefore be introduced.

Slovakia

In what concerns the compliance with Article 15 of the EED, Slovakian NEEAP does not report measures regarding the regulatory work to be done in order to introduce energy efficiency criteria in network tariffs.

On the other hand, **Slovakia has already in place some Demand Response measures that were previously introduced. E.g.: the reductions in electricity consumption during peak load; load management and off-peak electricity sales and the balancing of the load curve by promoting the night load**. A new act from 2012 establishes **compulsory throughput meters at all levels of the grid and at large consumers.** This will allow expanding demand side management to all consumers with an annual consumption of more than 4 MWh making it possible to track information required to manage the load, thus facilitating adjustments to the daily load curve. The Regulatory Office for

[26] On demand management, it provides that 'electricity companies, consumers and the system operator, in coordination with other agents, may draw up and apply measures which promote a better management of electricity demand and help optimise the load curve and/or energy saving and efficiency'. The law gives consumers the possibility to participate, either directly or through sellers, in the services included in the electricity production market in accordance with the applicable regulations.

[27] This royal decree provides that electricity production cost shall be determined based on the hourly price of the daily market during the billing period in question, raising consumer awareness of wholesale market prices deriving from the system demand curve and thus encouraging consumption outside peak hours.

Network Industries published **a methodology in 2013 guiding electricity undertakings to create and make available systemic services for the management of consumption by:** the shifting of the load from peak to off-peak times by final customers, taking into account the availability of renewable energy, energy from cogeneration and distributed generation; energy savings from demand management; demand reduction from energy efficiency measures undertaken by energy service providers, including energy service companies; the connection and dispatch of generation sources at lower voltage levels and by the connection of generation sources closer to the consumption site and by the storage of energy.

UK

Concerning measures aiming to remove possible detrimental tariff incentives, in the NEEAP it is just mentioned that transmission and distribution tariffs in Great Britain and Northern Ireland are not detrimental to overall efficiency or the participation of Demand Response in relevant markets.

Concerning planned or adopted measures to incentivise network operators to improve efficiency through infrastructure design and operation, the Ofgem's RIIO price control framework applied in Great Britain and the distribution and transmission tariff systems applied in Northern Ireland are indicated as existing measures fulfilling the relevant requirements of Art. 15(4).

Concerning measures to ensure that tariffs allow suppliers to improve consumer participation in system efficiency including Demand Response, in the NEEAP it is just mentioned that for both electricity and gas, there are no provisions contained within the use of system tariffs for electricity transmission and distribution that prevent suppliers from improving consumer participation in achieving sustainable development objectives.

Based on information in the NEEAP, promotion of Demand Response seems to be mainly addressed by network tariffs. Smart meters are also described as a means to support Demand Response in the future.

Chapter 5. Analysis of the JRC 2015 DR survey and updated MS fiches

The following chapters provide a national level analysis of Demand Response in the individual Member States. All chapters review the currently running practices, the background, and the regulatory framework, that results either from the transposition of the EED or established for other reasons.

Austria

Context

Starting in 2013, the Austrian TSO, APG, opened the Balancing Market to aggregation and Demand Response with the active support of E-Control. Though Austria has significant over capacity within the wholesale markets, and the balancing market prices were seen as unnecessarily high, Demand Response was understood as a means of increasing market liquidity and lowering costs. Though significant historical regulatory barriers remain, today there are over 5 aggregators in the country. In 2014 several amendments in the preconditions for the prequalification were implemented to ease the aggregation of demand resources. In particular, it is now possible to pool loads and the reduction of minimum size of a technical unit contributes to this. Retailers are not paid sourcing costs within the balancing markets.

The wholesale market remains closed to aggregated demand, though in principal Demand Response could access the EPEX day-ahead market. Practically, however, no such activity is currently registered. There are also unjustified historical barriers which remain, such as that each consumer participating in a balancing market may be required to install a dedicated telephone line, costing several thousand euros. These will take time prior to being removed.

Table 3. *Status of technical modalities and market opening*[28]

ENTSO-E's terminology	APG's terminology		Tot. Capacity Contracted	Aggregated Load Accepted
FCR	Primary Control Symmetric	+ / –	67 MW	No (symmetrical)
FRR	Secondary Control	+	200 MW	Yes
		–	200 MW	Yes
RR	Tertiary Control A-symmetric	+	280 MW	Yes
		–	125 MW	Yes

Wholesale Market

Currently there is no Demand Response participation on the EPEX spot market from Austria, although in principle Virtual Power Plants (VPP), (including demand-side flexibility), could participate in the day-ahead market.

[28] Source : SEDC DR Map 2015

Ancillary Services

Primary control is tendered on a weekly basis. However, only symmetric bids with a minimum size of 2 MW are accepted, making consumer participation difficult, a customer will often not be able to change their consumption pattern in a perfectly symmetric manner. Markets open to consumers do not require symmetric bids. **Tertiary control** is tendered on a weekly basis, with separate tenders for weekdays and weekends, both split into 6 four-hour windows. In addition, a day-ahead auction for the same time window is held, with however only an utilisation payment and no availability payment included.

Secondary Control: This market is one of the few short term, auction-based markets open to demand side resources in Europe. The market is split into 3 products from 8:00 to 20:00 on weekdays, 20:00-8:00 weeknights and weekends. The duration of each call is up to 4 hours, with a 10-hour rest period between calls (to allow consumers a guaranteed break in activations). A customer can offer asymmetrical bids, which means they can either increase or decrease consumption but do not have to be able to do both. Weekly bids are held which set the price for the customer's availability. The separation of positive and negative regulation supports demand-side participation as does the 3 time windows. This allows a consumer/aggregator to choose and bid into the time window appropriate for them. It should be noted that a 4-hour duration requirement, though a significant improvement over 16 hours, is still not optimal. Consumers can be fully engaged when the requirement is lowered to 1-2 hours.

Daily energy auctions are held for the energy component of the call as customers are paid both to be available for the week and for the energy they shift. One Austrian aggregator indicated that in the 4 months he has been activated 140 times[29], indicating a fluid and successful market design.

Status of regulation concerning aggregators

Aggregation is legal, however the role of the independent aggregator is not yet protected from potential entry barriers.

An independent third-party aggregator needs to inform and contract with the BRP/retailer in order to use the flexibility of Demand Response resource (for the balancing market). The delays and increase in costs slows the deployment and lowers the participation of aggregated Demand Response in the balancing markets. There is no compensation mechanism in place for retailers' revenue losses caused by a third party aggregation; however, as consumers are only active in the balancing markets almost no energy is displaced. The cost of calculating, measuring, and communicating the sourcing cost could potentially be higher than the costs themselves.

Prior to opening the wholesale market where more energy is shifted or saved however, this issue would require review.

Network Charges

In Austria, efficiency is encouraged by not penalising consumers for participating in Demand Response, and changing their consumption profile. The Austrian DSOs separate balancing energy from normal consumption when calculating network charges, and charging for balancing energy at a much lower rate.

[29] Frequency response requires small, automated adjustments in consumer consumption patterns. Therefore 140 activations is possible due to the fact that these adjustments will not be noticeable to the consumer.

This is a straightforward solution that could be adopted in other Member States such as Germany. Better still would be to transition to tariff designs which are more cost-reflective. A customer's individual peak demand is rarely a strong driver of network costs, as it only affects the sizing of dedicated connection assets. Tariffs based on the customer's contribution to peak demand on the network are more cost-reflective and less likely to discourage the provision of flexibility.

Conclusions

While Demand Response and aggregation is legal, the business case is relatively weak. Aggregators can only attract customers with large amounts of flexible load and/or backup generation (e.g. industry) to contribute to a pool. This is due to the cumbersome rules surrounding market entry, the cost of prequalification and other historical regulations designed for centralised generation units. That said, important progress has been made in bringing the market design in line with demand side capabilities, in a manner which is relatively unique in Europe. In order to progress further it will be necessary to: simplify surrounding processes, protect the access of independent aggregators to consumers, open the wholesale markets to demand side resources and clarify issues surrounding the sourcing costs for the retailer.

Main Market Enablers

The auction process and market design of the Secondary Control market enable Demand Response. Main enablers include:

- **Market design:**
  - availability payments auctioned on a weekly basis,
  - the daily auction process for energy,
  - the asymmetrical bids allowed in the secondary control market, and
  - the three bidding periods. These are all important enablers and could be used as a template within other Member States, or within the standardised products within the European Network Codes.
- **DSO Ruling:**
  - In Austria efficiency is encouraged by not penalising consumers for participating in Demand Response, and changing their consumption profile. The Austrian DSOs separate out balancing energy from normal consumption when calculating network charges, and charging for the balancing energy at a much lower rate

Main Market Barriers

- **Technical modalities** –
  - Prequalification requirements: Prequalification is carried out at the level of the individual consumer.
  - Risk assessment is not adjusted to the participant: it is important that prequalification, insurance and other procedures are proportional to the risk posed by a single consumer to system security. Without this, each consumer is treated as if they are a centralised generation unit and the procedural and administrative burdens become arduous.
  - The procedure is expensive and slow: The official prequalification process of APG requires a minimum of 3 months. However, the process can also last longer due to additional questions, the need for clarification or an error/gap in the APG's own rules.

- The requirement that each consumer install a dedicated telephone line costing between 10,000-20,000 euros.
- A remaining barrier is the 4-hour availability requirement.

The length of the process, the fact that each programme must be pre-qualified separately and the complexity of the paperwork, all add to the cost of each consumer's participation and ensures that only the largest customers have access to the markets either alone or through aggregation. This is an example of the process itself shrinking the size of the available pool of resource.

Belgium

Context

Belgium has suffered from periods of severe capacity shortages due to technical issues with multiple nuclear power plants over the last 3 years. In response, efforts have been made to enable Demand Response and the entry of independent aggregators. As part of this effort, Elia has opened 5 of its 8 ancillary services programs to aggregated demand (load). Demand Response participates in the Primary and Tertiary Reserves, as well as in the Interruptible Contracts programme, classified under the Tertiary Reserve. However, the Secondary Reserve is not yet open. Additionally, a share of demand-side capacity is participating in the Strategic Reserve, introduced in 2014 to ensure a sufficient level of security of supply during the winter periods.

There are least three sharply differing views concerning the status of Demand Response in Belgium. In interviews and within the JRC Survey, **a consumer representative** states that they continue to have difficulty accessing the ancillary services markets and those they are unable to participate in the wholesale market, even after repeated requests for access. They view the ancillary services market opening as too limited and point out that it does not reflect or solve the full needs of the Belgian market for improved capacity. Indeed, participation in the spot market, Belpex, is currently limited only to a few large industrial consumers. The **aggregators** interviewed point to the opening of the ancillary services market as an important step forward and enabler of Demand Response within Belgium. However they also note that they are blocked from full participation in the balancing markets and from the wholesale markets, due to the fact that they must have the retailer's permission to enter these markets with a given consumer. **Elia**, the Belgium TSO, states that all markets are open to Demand Response in Belgium, including wholesale. They point out that consumers are able to access the wholesale and balancing markets through their retailer contracts with their retailer. They indicate that this should be sufficient.

The market entry issue is due to the fact that any demand side participant (consumer or aggregator) must have the retailer's permission prior to accessing markets, (as Elia states, a customer can participate through their supply contract). This consistently causes entry barriers, as retailers may not have the same incentives as consumers/aggregators for market entry.

Status of technical modalities and market opening [30]

Elia has opened the ancillary services markets, setting limitations on how much load may participate to allow for controlled growth. The latest market opening is Primary Frequency Control R1 Down, in 2015. Tertiary Frequency Control (R3), for example, started with a 60 MW limitation in 2013. Each year the ceiling has been reached and in 2016, the R3 market size will be 200 MW of Demand Response (50% of the market).

[30] Source: SEDC DR Map 2015

To expand further and participate in the wholesale and balancing markets it will be necessary to complete negotiations surrounding the standardised process designed to allow consumers and aggregators free access to the market. The Belgian Demand Response market will be unable to grow further without these processes in place. The negotiations have been underway for over a year but have not progressed further. Regulatory and policy intervention may be required to compete as the incumbent players lack the motivation for ensuring a successful conclusion to the discussions.

Table 4. Ancillary Services Markets open to aggregated demand[31]

ENTSO-E's terminology	Elia's terminology		Market size	Load Access & Participation[32]	Aggregated Load Accepted
FCR	Primary frequency control (R1)	R1-200mHz	28 MW	✗	✗
		R1-Down 100-200	27 MW	Yes	?
		R1-Load - 100 - 200(Up)	27 MW	27 MW	
FRR	Secondary reserve (R2)	R2-Down	140 MW	✗	✗
		R2-Up		✗	✗
FRR-M	Tertiary frequency control (R3)	R3-Prod	400 MW	✗	✗
		R3-DP		60 MW 200MW 2016-	
FRR-M	Tertiary frequency control Interruptible clients (R3 ICH)		261 MW	261 MW	
RR	Voltage control and reactive power control		2700 MVAr	✗	✗
RR	Black start		n/a	✗	✗
RR	Strategic Reserve (SR)	SGR	750 MW	✗	✗
		SDR	97 MW*	97 MW*	

Ancillary Services and Balancing Market

Primary and Tertiary Reserves allow Demand Response participation, whereas Secondary Reserve does not. In addition, Demand Response represents about one tenth of the capacity involved in the Strategic Reserve. This reserve has been introduced in 2014[33] to ensure a sufficient level of security of supply during the winter periods, (in the context of an important reduction of nuclear generation, due to the recent simultaneous breakdown of nuclear reactors. Finally, load flexibility is provided through the Interruptible Contracts programme, which is dedicated to Demand Response.

[31] Source : SEDC DR Map 2015

[32] Elia (2015a): "Required total volumes of ancillary services for year 2015, for R1, R2, R3 and R3-ICH", available at: http://www.elia.be/en/retailers/purchasing-categories/energy-purchases/Ancillary-Services-Volumes-Prices (retrieved on 15th April 2015)

[33] Belgian Government (2014): Law of 26 March 2014, art. 5, published on the Official Gazette n. 97/2014

DSO-connected consumers can participate in R3-DP (since 2014) and SDR as from 2015-16. Other products might open to DSO consumers in the future, though the remaining issues with the lack of transparency concerning DSO blocking of a given consumer's access put this into question. DSOs have gained the right to block consumer access to Demand Response to avoid regional capacity issues. This in itself may be acceptable, however they are not required to measure or prove a potential issue. They are also not required to reimburse the TSO, aggregator or consumer for this decision. This lowers the interest of service providers to engage with DSO connected customers as it adds an extra element of project risk in an already difficult market.

Wholesale Market

Electricity consumers can enter demand bids with indication of price in the power exchange Belpex Spot. The participation remains low, due to remaining barriers, such as the requirement for aggregators to sign agreements with the consumer's retailer/BRP or becoming a BRP. Furthermore, the share of the electricity traded in the spot market is still low in comparison with the total market volume due to the fact that retailers tend to make bi-lateral agreements with generators, who they may also own.

Status of Regulation Concerning Aggregators:

Aggregation is legal but not enabled outside the ancillary services market, due to remaining barriers. In the wholesale market the consumer may only participate if there is a direct agreement with his retailer, and in the balancing market they require the Retailer's/BRPs permission. If a retailer wishes to provide aggregation services to their customers, they may do so within their own balancing perimeter. In order for this issue to be solved, it will be necessary for Belgium to establish standardised processes enabling market access for consumers/aggregators, which is fully independent of the retailer. These should include a process for the assessment of volumes, data exchange, a governance structure and (if desired) a compensation methodology to be used between the BRP and aggregator/consumer. Without these standardised methodologies in place – aggregation is not fully enabled in a market.

Conclusions

This market is an example of a market design which is moving away from a generation-centric model and endeavouring to capture the strengths of both resources.

Main Market Enablers

Elia has been pro-active in enabling Demand Response within the ancillary services markets.

- **Innovative, appropriate market design:** Primary Frequency Control was re-designed to maximise the capabilities of both the generation and demand side resources.
    - The market was divided into three parts; part 1 is a symmetrical program – suitable for generators. Part 2 and 3 are **asymmetrical** programs, one for increasing and the other for decreasing consumption.
    - These are activated between + / - 100-200mHz allowing consumers to balance the larger changes in frequency. This solves two issues – 1) consumer load is well suited for following large changes in frequency, often at a lower cost than generation 2) the larger shifts means that the consumer is activated less often.

Main Market Barriers

- **Market design:** Tenders to participate in the Markets are Held Annually, therefore a significant up-front sales and marketing investment is required to secure customers with the risk that no contract will be won. This limits Demand Response potential and some improvements might be studied. For example in Austria the auction for the same markets takes place on a weekly basis, allowing for much more granular participation.
- **Inappropriate technical modalities:** Measurement Provisions currently do not enable full access of customer load to market. Volatility of local energy production (e.g. from locally installed wind turbines) or inflexible consumption, at one site cannot be isolated from the available flexible power/load potential at that same location, and a large amount of the available Demand Response potential remains inaccessible for aggregation. As such, there is a need for "meter behind meter" provisions in the settlement process, allowing full measurement of available load (except R1).
- **Network issues - DSO connected consumers incur extra investment risk** -For R3-DP and in the forecast for SDR 2015-2016, the prequalification process required by the DSO limits the available Demand Response potential and hinders Demand Response sourcing efficiency. This is due to the fact that the DSOs have difficulty evaluating the potential congestion issues linked to market driven behaviour of DSO consumers and therefore tend to be cautious and discriminating towards allowing Demand Response. Currently the DSO is able to block or refuse consumer access to Demand Response without taking responsibility for the costs incurred by the consumer, aggregator and TSO, or even providing transparent measurement and risk calculation (in fact the DSO is not required to take accurate measurements of the risks involved). This lack of transparency and measurement requirements will become a significant barrier to Demand Response development if the issue remains unsolved.
- **Shut Markets:** The Wholesale and Balancing Markets are still shut to demand side resources, unless the retailer offers aggregation services to their customers. However it is important that those who wish to provide Demand Response or participate in a program, are able to do so. In order for the market to be opened to large consumers and aggregators, it will be necessary for Belgium to establish standardised processes enabling market access for consumers/aggregators, which is fully independent of the retailer. These should include processes for: for the assessment of volumes, data exchange, a governance structure and (if desired) a compensation methodology to be used between the BRP and aggregator/consumer. Without these standardised methodologies in place aggregation has not been fully enabled in a market.
    - Negotiations have been underway for over a year. Regulatory and policy intervention may be required to resolve the remaining issues, as the incumbent players lack the motivation for ensuring a successful conclusion.

The Nordic countries: Denmark, Finland, Sweden

Context

Though they have separate TSOs, Norway, Finland, Sweden and Denmark share a single electricity market and regulation. This includes the regulation concerning Demand Response and aggregation.

The Nordics have enabled Demand Response to varying degrees within their ancillary services markets and consumers can participate in Demand Response through their supply contracts within the Nordic Spot Market and national balancing markets – assuming these are offered by their retailer. There are successful examples, such as Helsinki Energy, but overall Demand Response requires significant resources, re-training of staff and an engagement level unfamiliar to retailers – uptake is therefore slow.

Nordic Regulation does not define a role for independent aggregators. Aggregators must have the retailer's permission to aggregate load and may only pool resources within a given balancing parameter (therefore they can only aggregate the retailer's customers in a given balancing region, severely shrinking the size of the available pool).

However, Nordic regulation does allow Prequalification for participating in a market to be carried out at the aggregated pool level, rather than for each consumer individually. This is an important enabler as it allows the aggregated pool of consumer load to be treated as a single resource, maximising the group's joint potential. It also allows the aggregator to act as mediator for the consumer, protecting them from onerous and complex technical pre-qualification measures.

The Nordics are balanced largely by Norwegian hydropower. The high water levels in recent years have lowered the spot market price below the marginal cost of coal-fired generation. Yet within the next 5-6 years over 6,000MW of new **inflexible** capacity will be built – wind generation in Sweden and nuclear in Finland. At the same time, Norway is exporting more of its hydropower to central Europe. The balance in the market is therefore changing, while prices in the wholesale and spot markets remain low – less and less of the generation available is flexible. The Nordic TSOs have a project to review the Reserves allocation in the Nordics - a portion of these reserves will be Demand Response.

Denmark

The use of Demand Response in Denmark remains quite limited. In theory, electricity consumers are allowed to participate in every ancillary service market. However, due to the regulatory environment, participation remains limited. Demand Response aggregation takes place only through retailers, and there are no independent aggregators in the Danish market today. The balancing programmes are mainly designed around the characteristics of generators, leading to a situation where only the largest consumption units are able to participate. The lack of access to programs is highlighted within the JRC survey; an industry representative points to the fact that Demand Response is possible within a given balancing area and in most markets, whereas a consumer representative states that no programs are offered as there are no aggregators, no service providers.

Finland

Active market participation of demand and aggregation are possible, but limitations still exist. The contractual relationship between aggregators and BRPs remains an important barrier. Moreover aggregating loads under different BRPs' area is not allowed, even if the aggregator is able to provide BRPs the adequate information to mitigate their balancing risks. Today, aggregators operate in the frequency control, in the tertiary reserve and in the spot market, while only pilot projects are underway in the secondary reserve and in the frequency normal reserve. The large minimum bid size for some products limit the full potential of Demand Response. The payments are quite attractive for the ancillary products, but with some penalisation compared to the generation ones. The TSO Fingrid has also contracts with the largest industrial consumers to provide emergency reserves.

Sweden

Flexibility is provided by hydropower plants in the north of Sweden (SE1 and SE2), while thermal plants are sometimes activated in the south of Sweden, in case of congestion or in case of peak demand. Demand Response participation and aggregation of demand-side resources are legally possible in Sweden. However, wider Demand Response participation could be triggered with the definition of appropriate roles and responsibilities between players, which would allow for consumers to freely choose their Demand Response service provider, while protecting all market participants.

Product requirements limit the possibility for Demand Response to participate as they remain generation centric. In the Secondary, Tertiary Reserve and the RPM, the minimum bid size represents a significant barrier for wide participation, for example. Demand-side resources also participate in the spot market; however, prices are currently too low to make this interesting for retailers (the only actors with free access).

Status of technical modalities and market opening[34]

Denmark

The Danish transmission system is divided into two areas (Western-DK1 & Eastern-DK2). DK1 is synchronous with Germany and the Continental grid, whereas DK2 is coupled with the Nordic one. A connection exists between them, called "Storebælt HVDC" (the Great Belt Power Link). This situation influences the structure and use of Demand Response in Denmark as some programmes are separate for each area. The substantial share of Danish ancillary services is procured from neighbouring countries. As a result, it is less feasible to assess the exact volumes contracted in Denmark. The table below presents the total volumes, contracted from Denmark or neighbouring countries.

Table 5. Ancillary Services Markets open to aggregated demand[35]

ENTSO-E's terminology	TSO's terminology	Tot. Capacity Contracted	Load Access & Participation	Aggregated Load Accepted
FCR	Primary Reserve (DK1)	≈23 MW	*	*(23 MW[36])
FRRa	Secondary Reserve (DK1)	≈100 MW	*	*
FCR	Frequency-controlled normal operation reserve (DK2)	≈22 MW	*	*
FCR	Frequency-controlled disturbance reserve (DK2)	37 MW	*	*
FRRm	Tertiary (Manual) Reserve (DK1 and DK2)	≈868MW	* (555 MW)	*
RR	Short-circuit power, reactive reserves and voltage control (DK1 and DK2)	0 MW	*	*
-	Strategic Reserves (DK2)	200 MW	*	*

[34] SEDC, DR Map 2015
[35] Source : SEDC DR Map 2015
[36] Electrical boilers cover all demand for negative primary reserves (i.e. down regulation)

Finland

All products are legally open to Demand Response, with some limitations. However, only pilot projects are underway in the Primary Reserve normal (FCR-N), and Secondary Reserve (FRR-A). The following table presents an overview of the different programmes and their respective sizes, where public data are available.

Table 6. *Ancillary Services Markets open to aggregated demand*[37]

ENTSO-E's terminology	TSO's terminology	Market size	Load Access & Participation[38]	Aggregated Load Accepted
FCR	Frequency controlled normal operation reserve (FCR-N)	140 MW [39,40]	*(pilots)	*
	Frequency controlled disturbance reserve (FCR-D)	260 MW	*70 MW	*
FRR -A	Automatic frequency restoration reserve (FRR-A)	70 MW**Error! ookmark not defined.'Error! Bookmark not defined.**	* (pilots)	*
FRR-M	Fast disturbance reserve (FRR-M)	1.614 MW**Error! ookmark not defined.'Error! Bookmark not defined.**	*385 MW	*
RR	Strategic reserves	365 MW	*40 MW	*
	Balancing Market (RPM)	300 MWh[41]	* 100-400 MW	*

Sweden

The following table shows the electricity market product or sub-products and underlines where Demand Response and aggregated loads can participate, including related market sizes.

[37] Source : SEDC DR Map 2015

[38] Fingrid (2014a): "Demand-side management", available at: http://www.fingrid.fi/en/electricity-market/Demand-Side_Management/Pages/default.aspx (retrieved on 15th April 2015)

[39] Fingrid (2014b): "Reserves", available at: http://www.fingrid.fi/en/powersystem/reserves/Pages/default.aspx (retrieved on 15th April 2015)

[40] Fingrid (2014c): "Tilannekatsaus varavoimalaitoksiin, nopeaan häiriöreserviin sekä kysyntäjoustoon (Status of fast reserves and elasticity of demand)", available at: http://www.fingrid.fi/fi/asiakkaat/asiakasliitteet/Kayttotoimikunta/2014/21.5.2014/Tilannekatsaus%20varavoimalaitoksiin%20nopeaan%20h%C3%A4iri%C3%B6reserviin%20kysynt%C3%A4joustoon.pdf (retrieved on 15th April 2015)

[41] NordPool Spot (2014a), Market values in Finland, calculated at sum between up-regulation and down-regulation

Table 7. *Ancillary Services Markets open to aggregated demand*[42]

ENTSO-E's terminology	SVK's terminology	Market size	Load Access & Participation (MW)	Aggregated Load Accepted
FCR	Frequency Containment Reserves for normal operating band (FCR-N)	230 MW[43]	*≈0	*
	Frequency Containment Reserves for disturbances (FCR-D)	412 MW[44]	*≈0	*
FRR-A	Automatic Frequency Restoration Reserves (FRR-A)	still limited	*≈0	*
FRR-M	Fast disturbance reserve (FRR-M)	1.290 MW[45]	*≈10 MW	*
RR	Strategic Reserve / Peak Power Reserve[46]	1.500 MW	*626 MW	*
	Balancing Market (RPM)	1,6 TWh[47]	*	*

Status of regulations concerning aggregators

Retailers are allowed to become aggregators or they may outsource this service.

The role of the independent aggregator is not defined within Nordic regulation. In order to be an independent third-party aggregator, the company should register as a BRP. In Finland, to obtain this status, the fee is a reasonable € 200/monthly, but a bank deposit of minimum € 200.000 is required in case of bankruptcy. In Sweden, registering as a BRP requires an annual fee of about € 2500 per year, and the installation of an electronic reporting system connected to the exchange platform Ediel (or signing a contract with an agent that has such equipment). *Even in that case the aggregator would have to sign an agreement with the consumer's BRP in order to engage them.* Otherwise, the aggregators can also operate as service providers for a retailer. In this case, the aggregator reaches a contractual agreement with the retailer and pools loads from his balancing group according to the contract.

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[42] Source : SEDC DR Map 2015

[43] ENSTO-E (2006): "System Operation Agreement" Ibid. par. 4.1.1

[44] ENSTO-E (2006): "System Operation Agreement" Ibid., par. 4.1.2

[45] ENSTO-E (2006): "System Operation Agreement" Ibid., par. 4.2

[46] Elforsk (2014): "Rapport 14:29, Demand Response in the strategic reserve, The Case of Sweden", p. 31, resources for the year 2014/2015, available at: www.elforsk.se/Documents/Market%20Design/projects/ER_14_29.pdf

[47] NordPool Spot (2014), RPM 2014 value, available at: http://www.nordpoolspot.com/Market-data1/Regulating-Power1/Regulating-Power--Area1/NO11/Norway/?view=table (retrieved on 30th April 2015)

In **Denmark** there are no aggregators while in **Sweden** and **Finland**, thus far, the third-party aggregators have been able to protect the retailers from financial losses on lost energy sales, through efficient and timely communication. However, the bilateral agreement requirement severely limits the ability of the consumers to choose service providers, since it gives the possibility to the retailers/BRPs to decide with whom and under which conditions they are allowed to engage with an aggregator.

Therefore, to the extent aggregation is defined in the Nordics, it is done so as a means of protecting/maintaining the current market structure and does not focus on enabling consumer access to service providers or Demand Response. Regulators assume that retailers will provide these services, when in fact there are significant business model issues in place for retailers which hamper their ability to create a positive business case (see Introduction). This consistently causes entry barriers, as retailers may not have the same incentives as consumers/aggregators for market entry.

The Nordic have focused on enabling implicit Demand Response through smart meter rollout and dynamic tariffs. These tariffs enable consumers to lower their energy bills in the short to medium term. First, the customers, by accepting volatility in prices, no longer pay the retailer's risk premium, which lowers retail energy prices when averaged over an extended period of time (even without any consumer reaction to price).

Consumers also have the opportunity to adapt their energy consumption over time to choose cheaper periods. That said, the programs are not always directed toward providing consumer feedback or encouraging demand-side flexibility, which would require communication technology and/or some form of home/business automation. These automation offerings are currently being developed and deployed in limited areas, such as the Helsinki region. Dong Energy, Vattenfall and Fortum have conducted pilots but are finding it difficult to create a viable business model- on average prices are low and the upfront cost of the programs are relatively high. That said, as balancing costs rise over the next 5 years, with the introduction of further inflexible generation, this situation may change.

Conclusions

Main Market Enablers

All Nordic countries allow retailers to carry out aggregated Demand Response in partial fulfilment of Article 15 in the Energy Efficiency directive. Sweden and Denmark have as yet to create viable products, while the Finnish TSO has made progress in adjusting the ancillary services market to optimise demand side capabilities.

- **Technical Modality for aggregation:**
    - In Denmark, Finland and Sweden, Prequalification for participating in a market is measured at the aggregated pool level, rather than for each consumer individually. This is an important enabler as it allows the aggregated pool of consumer load to be treated as a single resource, maximising the group's joint potential. It also allows the aggregator to act as mediator for the consumer, protecting them from onerous and complex technical pre-qualification measures.
    - No minimum required size for consumer participation
    - No technical requirements for the single unit.
- **Open Markets to aggregated demand:** Ancillary service markets are open to Demand Response.
- **Adjusted technical modalities for residential and Commercial Industrial Consumers:**

- Fingrid has worked actively with national consumers (household to industrial) to enable participation.
- They are also looking to expand these capabilities through automating **residential heating** controls.

- Finland and the UK are therefore two of the first countries where **residential load** is used in the Ancillary services markets.

Main Market Barriers

- **Enabling independent aggregation:** Aggregation is legally possible in Denmark, Finland and Sweden, however the lack of clarity of roles and responsibilities between aggregators and BRP/retailers represents an important competition issue.
- **Onerouse remaining technical modalities:**
- Barriers remain in place in many Nordic market which have already been successfully removed elsewhere in Europe. Program requirements are still largely generation centric. This blocks all participants from entry – including retailers and large consumers.
- **Denmark:**
  - The market barriers remaining in Denmark indicate that while open in name, the requirements have not as yet been reviewed to ensure they provide a level playing field between generation and demand. Examples are below:

    - The rules for ancillary services are mainly designed around generation-standards. For example the requirement to have an online metering system constitutes a substantial cost for any entity willing to provide its services.
    - **Primary Reserve**. In DK1, the primary reserve is an automatically operated reserve for frequency containment. It requires very short delivery time and too frequent activations for traditional Demand Response to cope with – except for some MW-scale electric boilers.
    - In DK2 primary reserve, the TSO requires delivery of 50 % within 5 seconds and 100 % within the next 25 seconds, thus most of Demand Response units are disqualified. For example, some back-up generators can provide 50% in 6 seconds, but this is not accepted. This requirement may change with the adoption of the European Network Codes.
    - The frequency restoration reserve requires **symmetric** bidding[48]. In markets such as the UK, Belgium, Austria, France, and Switzerland, the requirement for symmetric bidding was removed in order to enable consumers to participate.
    - Secondary Reserve. Today, the Secondary Reserve Market requires upward and downward regulation/symmetrical bids[33]. Furthermore, the whole volume of Secondary Reserve is currently contracted from Norway.

[48] A requirement for symmetrical bids acts as a market barrier to consumer participation. Consumers can rarely generate and consume in equal measure. In Member states where the TSO is willing to enable Demand Response asymmetrical bids are allowed.

- Tertiary Reserve. Common rules apply to both DK1 and DK2. The main barrier consists in the high minimum bid (10 MW), this reserve being still manually operated.
- The participation in the Tertiary Reserves Market requires a control centre operating 24/7, which represents a cost barrier for a large consumer, aggregator or small retailer[49].
- The Strategic Reserves are procured through a one-off tender with participation of both consumption and production units.

- **Finland**
  - The markets are either in the pilot phase or are made up of bi-lateral contracts with large consumers at this stage.
- **Sweden**
  - **Onerous remaining technical modalities:** With the current structure, Demand Response cannot cope with the product requirements for Primary (FCR-N, FCR-D) and Secondary (FRR-A) Reserves.
  - Demand Response could participate with provisions that would make these Reserves more technically accessible (e.g. activation only for deviations above 100 MHz – which leads to limited times of activation, and thus to less impact in the industrial/commercial/domestic processes).
  - With regard to the Tertiary Reserve (FRR-M), the main barrier is the high minimum bid[50].

France

Context

France is the only Member State in Europe, which has opened both the ancillary services markets and wholesale market to Demand Response and independent aggregators. This is made possible because the relationship between aggregators and retailers/BRPs has been regulated in 2013 and a standardised framework is put in place. It is also one of only 3 Member States (Finland, GB and France) where residential consumers are also engaged[51]. However the high mandated cost of the retailer's sourcing costs will continue to block market growth within the wholesale markets, as almost all revenues earned must be paid back to the retailer by the aggregator and consumers.

Since 2003, large industrial customers been participated in the balancing mechanism, and from 2007, the first pilots were run in order to introduce aggregated residential load to the mechanism. In 2014, for the first time an industrial consumer provided its energy reduction as a FCR or Primary

[49] EURISCO ApS (2013): "Activating electricity demand as regulating power. Flexpower – testing a market design proposal", p. 8, available at: http://www.eurisco.dk/images/1027_flexpower_activating_electricity_demand_as_regulating_power.pdf (retrieved on 10 June 2015).

[50] Since 1st November 2011, the Swedish electricity market has been divided into four distinct price areas (i.e. S1, S2, S3, S4).

[51] Residential consumers are most often provided with dynamic pricing programs only through dynamic tariffs.

Reserve[52]. This programme, together with Secondary Reserve (FRRa), has been accessible to load participation since 1 July 2014.

The NEBEF ("*Notification d'Échange de Blocs d'Effacement*") was launched in 2014, creating a mechanism that allows curtailed load to bid as energy directly into the wholesale electricity market. During the first year, the volume amounted to a modest figure of 313 MWh. Between 2014 and 2015 volumes decreased further, and in 2015 the market generated only **€1,783** for aggregators. The low wholesale market prices and requirements for payment of sourcing costs to the retailer are the main issues here.

The capacity market for 2017 and beyond should also open new possibilities for Demand Response.

Status of technical modalities and market opening[53]

RTE's products are adapted to Demand Response and have been improved further to be aggregation-friendly, i.e. to allow aggregation irrespective of the type of network, metering, electricity retailer, BRP, etc. However, certain consumers with a curtailment clause in their retailer contract are blocked from participating in forms of Demand Response.

The charts below show ancillary services and other mechanisms where Demand Response participation is allowed:

Table 8. ***Ancillary Services Markets open to aggregated demand***[54]

ENTSO-E's terminology	TSO's terminology	Tot. Capacity Contracted[55]	Load Access & Participation	Aggregated Load Accepted
FCR	Primary Control (*Réglage Primaire de Fréquence*)	600 – 700 MW	*(≈40MW)	*
FRRa	Secondary Control (*Réglage Secondaire de Fréquence*)	600 – 1000 MW	*(0 MW)	*(0 MW)
FRRm	Fast Reserve (*Réserves rapides*)	Max. 1000 MW	*	*
RR	Complementary Reserve (*Réserves complémentaires*)	Max. 500 MW	*	*
DSR - RR	Demand Response Call for Tender (*Appel d'Offres d'Effacement*)	2014: max. 750 MW 2015: max. 1800 MW	* (2014: 750MW, 2015: 1800MW)	*

[52] RTE (2014) : "Les consommateurs industriels désormais fournisseurs de services pour la fréquence du système électrique français", available at : http://clients.rte-france.com/lang/fr/clients_producteurs/services/actualites.jsp?id=9693&mode=detail (retrieved on 20 May 2015)

[53] SEDC, DR Map 2015

[54] Source : SEDC DR Map 2015

[55] RTE (2009), "Documentation Technique de Référence, Chapitre 4 – Contribution des utilisateurs aux performances du RPT, Article 4.1 – Réglage Fréquence/Puissance", available at:

http://www.rte-france.com/uploads/Mediatheque_docs/offres_services/reftech/24-04-09_article_4-1__v3.pdf (retrieved on 10 June 2015)

Wholesale Market

The test phase of the Demand Response mechanism called NEBEF took place from December 2013 to December 2014 on the wholesale market. The final rules of the NEBEF mechanism were issued on 19 December 2014[56]. The volume activated during the experimentation phase was quite modest (310 MWh), partially due to a mild winter. In 2014, the total volume traded on the Epex Spot day ahead market amounted to 67,8 TWh. Between 2014 and 2015 volumes decreased, and in 2015 the market generated only €1,783 for aggregators. The low wholesale market prices are the main issue here. However the energy payments for the retailer's sourcing costs also drove down revenues.

In addition, Demand Response based on retail prices has been valued based on wholesale electricity market prices for more than 40 years. France has a history of retail Demand Response programmes lead by EDF, the French incumbent utility. The programmes were based on variable retail price schemes, and EDF runs both residential and industrial load management programmes.

Capacity Market

The prices on the balancing market do not reveal the full value of flexibility and capacity services provided through Demand Response. The capacity market could help address this issue, assuming it truly enables demand-side participation. It is based on a decentralised market structure with an obligation for the retailer to buy capacity certificates up to the level of their portfolio peak consumption.

The market, due to start delivering in 2017, will be open to both generation and demand-side participation. The final rules applicable to the mechanism were issued on 22 January 2015. The product exchanged being "capacity", it will reflect only the availability of DR in the market[57]. Its effective activation will be counted through the balancing mechanism or NEBEF mechanism. This market could act as an important enabler for demand-side development. Demand Response operators are able to go through the certification process closer to real time than generators. Existing generators need to be certified 3 years ahead whilst Demand Response operators need to be certified only 1 year ahead of the delivery year. Such a solution is useful for Demand Response operators at it can give them bigger flexibility as far as planning their development is concerned. The Capacity market has some important enablers for Demand Response, such as the fact that the aggregator can bid in the market prior to contracting with the consumers. This allows them to know their price and what a consumer will earn, prior to approaching them.

However, the market will also allow EDF to be the only significant buyer and the main seller in the market, raising questions around open competition. (EDF will, by necessity, predominantly buy and sell to itself, and any aggregator looking to provide resources will have to complete with EDF's own generation fleet.) Therefore, although the market design is positive overall, with a significant improvement of the capacity market in Great Britain, there may be issues later on in the process.

[56] The list of players participating in NEBEF Mechanism is available on the French TSO' website : https://clients.rte-france.com/lang/fr/visiteurs/vie/nebef_operateurs.jsp

[57] To participate, the Demand Response operator will have to prove its ability to activate Demand Response programmes matching the capacity it claims for in its portfolio.

Distribution Network

ERDF runs 15 demonstration projects, aiming at testing programmes that could allow for better network management. The projects range from RES integration to evaluation of so-called active demand solutions[58].

Ancillary Services

- **FCR** (*Primary Control*) **and FRRa** (*Secondary Control*)**.** Minimum schedules for FCR & FRRa are 1MW. FCR & FRRa are mandatory symmetrical products. From July 2014, Demand Response participation (certificated consumption sites, industrial & aggregated load as participants) is limited to the transmission grid and is based on bilateral contracts with generators[59].

  RTE is considering allowing asymmetrical products, Demand Response participation from distribution grid and more aggregation-friendly conditions in the near future.

  The market design has caused issues for new entrants. Prior to 2014, generators were required to provide frequency control for a fixed price. RTE did not wish to change this obligation when opening the market to Demand Response. They therefore allowed the generators to purchase demand side resources from consumers, assuming the consumers would be engaged by the generators if they could provide services at a lower price. However, this has proved complicated. The generators are centrally owned by EDF – meaning that there is only one buyer, and one main seller, giving EDF disproportionate market power. There are therefore questions surrounding potential market distortion and RTE is reviewing the model although aggregators have successfully engaged to a certain extent.

- **FRRm** (*fast reserves*) **and RR.** The minimum bid is set at 10 MW for FRRm and RR since April 2014. Although this is not the 1-5 MW requirement achieved in most Demand Response friendly markets in Europe, it is a significant improvement over the earlier 50 MW requirement.

  Experimentation for 1-10 MW Replacement Reserve is expected in April 2015 for RR and for FRRm in October 2015. As for the availability within FRRm, the RTE tender allows much flexibility: Demand Response to participate for certain days only (and not 24/7).

Rules surrounding aggregation

Independent aggregation is enabled in France and standardised processes have been put in place between the BRP/retailer and aggregator. Since 2014, there is no need for consumers or aggregators to contract with a BRP in order to provide its flexibility to the markets (Balancing, NEBEF, Capacity mechanisms). However, participation of Demand Response to FCR and FRRa is only possible through a secondary market. For this reason, consumers and aggregators have to sign bilateral contracts with producers (generators) to sell them their products.

Sourcing Costs are costs incurred by the BRP/retailer when they purchase electricity in advance of actual consumption, in order to ensure they will have sufficient amounts to stay in balance. When

[58] more information on ERDF's website, at the following address: http://www.erdf.fr/smart-grids-ou-reseaux-intelligents (retrieved on 10 June 2015)

[59] Thomas Veyrenc, "Market design for Demand Response: the French experience", presentation of July 3, 2014, International Energy Agency, available at: https://www.iea.org/media/workshops/2014/esapworkshopii/Thomas_Veyrenc.pdf (retrieved on 10 June 2015).

consumers lower their consumption, the BRP loses the money they spent purchasing this electricity. This loss is incurred *outside* any competitive activity and they therefore state that the aggregator should pay them for these losses. French aggregators working with industrial/commercial consumers, agree that this is a fair solution - in principle. They see the payment mechanism as a significant contributor to the smooth integration of aggregators and consumers in the market, and an important part of standardised process between aggregators and BRPs, (though they have concerns over how the costs are calculated). Aggregators working with residential consumers, who provide small loads, maintain that these payments destroy their business model and will keep residential consumers from accessing the markets. The issue has been challenged in court and through the parliament multiple times, by both sides.

The rules on the imbalance settlement and sourcing costs, is again under evaluation within on-going discussions on the new law on energy transition. In the balancing mechanism, ancillary services and wholesale markets, the BRP perimeter is corrected by the TSO after the load curtailment, so that the BRP does not face any imbalance due to Demand Response.

Network Tariffs: Time Of Use Tariffs are available (day/night) but both EDF and others consider that critical peak pricing should also be introduced (perhaps in order to strengthen any pricing signal from EDF). Network compensation mechanisms continue to encourage ERDF to invest in infrastructure rather than Demand Response or other efficiency mechanisms. However, unlike in Germany, Network tariffs do not actively penalise consumers who participate in Demand Response.

Conclusions:

Main Market Enablers

- **Open Markets:** The **open** wholesale, balancing and, eventually, the capacity market. France is the first and only Member State to open its wholesale market to aggregated Demand Response.
- **Enabled aggregators:** The **standardised process** between BRPs and aggregators is a significant enabler. This includes:
    - *Volumes*: Standardised processes for assessment of the traded energy between the BRP and the aggregator[60].
    - *Compensation*: A price formula to calculate the price for the transferred energy. In the case of demand reduction, the aggregator pays the BRP; in the case of demand enhancement, the BRP pays the aggregator. This price formula should reflect as closely as possible the average sourcing costs of the energy transferred, *however neither aggregators nor retailers seem satisfied with the formula currently used in France as it does not adequately reflect market prices.*
    - *Data Exchange:* A clear definition of what data needs to be provided to the BRP through the TSO, to ensure both the aggregator and the BRP can fulfil their obligations whilst not having to share commercially sensitive information.
    - *Governance structure:* An appeals process and an appeals body, in case any issues need to be resolved.
- **Technical modality enabling aggregation:** The **pooled load** has to fulfil requirements as an aggregate. This is a critical enabler of Demand Response as it allows the aggregator to act as

[60] i.e. the transfer of energy between the BRP's and the aggregator's balancing groups following a Demand Response dispatch.

mediator for consumers, protecting them from onerous technical pre-qualification measures and from costly duplication of procedures.

Main Market Barriers

- **Sourcing cost payments:** Within the wholesale markets these costs negate the profits of the aggregator and payment for the consumer
- **Market structure creating one buyer and seller:** Within the FRR and FCRa, aggregators must make agreements with EDF who buys and sells most of the resource in the market. This is a significant issue – not only are aggregators and generators competitors but EDF owns the generation fleet giving them a large amount of market power. This can be difficult for new entrants, though several have engaged successfully.
- **Technical modality:**
  - The standardised formula for **sourcing costs** does not properly reflect changes in market prices – and consumers and aggregators can be over-charged or retailers may not be properly compensated. They also pose an issue for residential consumers who tend to save more energy than industrial consumers and who have smaller profit margins per site than and industrial consumer. The service providers for residential consumers point to the fact that the total revenues from wholesale markets (NEBEF) left to DR operators in 2014 was limited to €14,032 (total for the full year for fifteen operators registered in 2014, operating more than 1,000 MW of DR in France), of which roughly 90% were handed back to retailers, leaving only 1,783 € to all DR operators for the full year.
  - A French DR representative states that '**ttechnical constraints** have been imposed on DR. In particular they name the required periods of availability, and control requirements. For instance, residential DR operating through automated electrical heating has a large potential in France, and could help face capacity issues related to peak periods; However these capacities face a significant barrier due to the requirement for availability during the full year - rather than only during peak
  - After Demand Response providers has reduced demand for a given period, e.g. 2 or 3 hours, they are not allowed to reduce it for the next period for the same duration; hence the value of DR is lowered by more than 50% as they can only participate in every other call; no such constraint is applicable to generation.
  - The requirements for entry in the Ancillary services markets are still relatively difficult. Minimum bid sizes are larger than average (10 MW aggregated load rather the standard 5 or 3 MW. Bidding is annual, and does not allow for a more granular decision making process. In addition, aggregation possibilities are limited (not all sites can be aggregated with other sites).

Other: Premium Explicit Demand Response in the residential sector (so called "*l'effacement résidentiel diffus*") can receive a premium for the consumption reductions that they provide. In 2015, the premium is set at the level of 16 €/MWh during daytime (7-23) and 2 €/MWh during night. There is a cap of 250 GWh per Demand Response operator, indicating the maximum amount of provided electricity reductions. This premium is financed through the tax included in the electricity tariffs. However, this premium is under question as a possible subsidy and its future is unclear at this stage.

Germany

Context

Currently, German market regulation creates significant barriers to most forms of Demand Response programme types, including both those provided by retailers and independent aggregators. However, the government is aware of these barriers and is undergoing a regulatory review to facilitate change. Conclusions of this review are summarised in 'An electricity market for the energy transition'. Should the suggested changes be fully implemented, the situation in Germany will improve. However as of today – Germany is unique in Europe for having opened almost all markets to Demand Response while at the same time making actual participation almost impossible.

With an announced plan to achieve 35% of renewable electricity supply by 2020 and the phasing out of nuclear power by 2022, the German energy system will integrate more and more de-centralised variable energy generation (wind, solar) as well as de-centralised energy generation by biomass and biogas, and will increase its needs in de-centralised flexibility. Situations where variable generation from wind and solar plants surpasses the general demand in the grid are expected to happen more frequently in the future.

There is a growing gap between the continuously low wholesale market prices and the much higher balancing market prices in Germany. The gap regularly exceeds a factor of 100, due to the fact that large amounts of renewable energy generation are available within intra-day markets. This has damaged the business case for flexible generation – mainly gas fired power plants – as they are moved out of merit order within the intra-day markets and replaced with wind and solar. On the other hand, growth in intermittent renewables, such as wind and solar generation, drives increasing demand for balancing services.

Today, a significant portion of demand-side flexibility in Germany remains untapped and will remain so, until important barriers are removed. Though Demand Response is legal, aggregation is only enabled for the retailer and these also face significant entry barriers. The wholesale market and re-dispatch (incl. winter grid reserve) are closed for Demand Response. Intra-day markets are open for consumers working through their retailer (assuming the retailer offers this service). There is no capacity market in Germany, but debate to introduce a capacity reserve, which, according to the design proposals in the German White Paper, will also be closed for Demand Response.[61]

[61] German Ministry of Economy and Energy (BMWI) (July 2015): "Ein Strommarkt für die Energiewende", available at: http://www.bmwi.de/DE/Mediathek/publikationen,did=718200.html

Status of technical modalities and market opening

Table 9. *Ancillary Services Markets open to aggregated demand*[62]

ENTSO-E's terminology	German TSOs' terminology		Tot. Capacity Contracted	Load Access & Participation	Aggregated Load Accepted
FCR	Primary control reserve (PCR)	+ / –	≤ 670 MW	*(n/a)	*
FRR	Secondary control reserve (SCR)	SCR +	≤ 2500 MW	*(n/a)	*
		SCR –	≤ 2500 MW	*(n/a)	*
mFRR	Minute reserve (MR)	MR +	1513 MW	*(n/a)	*
		MR –	1782 MW	*(n/a)	*
Interruptible loads	Immediately interruptible loads (SOL) – AbLaV[63]		465 MW	*(246 MW)	*
Interruptible loads	Quickly interruptible loads (SNL) – AbLaV		929 MW	*(648 MW)	*

In principle, Demand Response and aggregation are legally allowed in all German balancing market programmes. The actual share of flexible demand-side loads in the overall participation is however very hard to estimate and is likely to be low, due to entry barriers.[64]

Capacity Market

This capacity reserve is open for generation only, with no access for the demand side, and initially will encompass 2.7 GW of lignite coal power plants.

Wholesale Market

German electricity is being traded at the European Energy Exchange EEX in Leipzig (forward market) and the EPEX SPOT in Paris (day ahead and intraday market). However, for the time being, only very large consumers participate in the spot market, and as intraday trade for Demand Response is still closed, the participation of demand-side aggregators is practically non-existent. In contrast, 3rd party aggregation of distributed generation assets, e.g. wind, biomass and biogas is a viable business opportunity, as the distributed renewable energy unit chooses a BRP to market its generation. VPP (Virtual Power Plant) providers have started to participate, but with very small amounts of Demand Response in their portfolio.

Balancing Market and Ancillary Services

Programme requirements act as a barrier for the development of Demand Response in Germany.

The programmes in the balancing market are open to Demand Response resources. Re-dispatch is closed for Demand Response: both the continuously contracted re-dispatch resources as well as the "winter grid reserve" are generation-only, non-marketed programmes. The TSOs contract power plants bilaterally without going through any public auction or tendering process. **Interruptible Loads.** Interruptible loads are defined as large consumption units which are connected to the high

[62] Source : SEDC DR Map 2015
[63] Verordnung für abschaltbare Lasten

[64] 50Hertz/Amprion/TransnetBW/TenneT (2015): Data for control reserve, available at: https://www.regelleistung.net (retrieved on 4th April 2015)

and extra high voltage grid. Minimum bid-size is 50MW per consumer. **Primary Control Reserve:** Very little consumer participation takes place as the technical modalities are still designed around generation. **Secondary Control Reserve:** Consumers participating in SCR, **risk potential increases in grid tariffs for deviations** from their normal (flat) energy consumption profile, which constitutes a significant financial disincentive for offering their flexibility in this market. On top of this, resources must be able to be dispatched for up to 12 hours. This is despite the fact that tertiary reserves should able to take over from secondary reserves within a few hours. Both the call durations and the grid tariff structures represent serious barriers. **Minute Reserve:** Consumers participating in Minute Reserve again risk potential increases in grid tariffs for deviations from their normal (flat) energy consumption profile, which constitutes a significant market entry barrier.

DSO and Network Tariffs: As described above, most Distribution System Operators (DSOs) offer a so-called "Peak-Tariff (PT)" (Hochtarif, HT) which is used during the day and a so-called "Off-Peak Tariff (OPT)" (Niedertarif, NT) which is used during the night hours. The network fee reductions are applied to the "Off-Peak Tariff (OPT)". However, with increasing shares of renewable energy and distributed generation on the system, this simple distinction between day and night is out-dated and no longer covers on - and off-peak times. Going forward, it will be crucial to re-design the traditional scheme in a modern and flexible way.

Currently, customers using less than 100.000 kWh are paying volumetric rates. Since there are high charges, levies and network fees included in the price for each kWh, demand reduction and energy-efficient behaviour is already stimulated substantially. There are no obstacles for energy service companies to engage in the market. However, in light of the current discussion with increasing renewable energy self-consumption and the need to invest in distribution grids in order to cope with high shares of distributed generation, it will be necessary to restructure the network tariffs. Appropriate approaches may include more capacity based network tariffs.

DSO and Demand Response: In Germany, many large energy consumers (10 GWh per annum or more) have "individual network charges" which include discounts for maintaining a flat load profile. This is judged by multiplying the customer's peak demand by 7,000 "full load hours": to obtain the discount, the customer's annual consumption must remain **above** this level. This is problematic in two ways. First, the provision of ancillary services — especially negative reserves — by the customer may cause their peak demand to increase. Second, the regular provision of Demand Response (or the taking of energy efficiency measures) may cause the customer's annual consumption to fall.

For many customers in Germany, the risk of increased costs outweighs the potential rewards for ancillary services provision. In Austria, for example, this issue has been ameliorated by separating out balancing energy from normal consumption when calculating network charges, and charging for the balancing energy at a much lower rate. This is a straightforward solution that could be adopted in other Member States. Better still would be to transition to tariff designs, which are more cost-reflective. A customer's individual peak demand is rarely a strong driver of network costs, as it only affects the sizing of dedicated connection assets. Tariffs based on the customer's contribution to peak demand on the network are more cost-reflective and less likely to discourage the provision of flexibility.

Regulation concerning aggregation

Third-party aggregation is currently very difficult in Germany, due to regulatory barriers that require independent service providers (e.g. aggregators) to ask the bilateral permission of multiple parties – including the consumer's BRP, a potential competitor – prior to offering a consumer's flexibility into the market. In total, an aggregator operating in Germany has to negotiate and sign five different contracts:

- Consumer (agreement on participation)

- TSO (prequalification (PQ), supply of reserve energy)
- DSO (agreement, report of non-availability, confirmation for PQ)
- Consumer's BRP (agreement on schedule exchange, BRP-approval for PQ)
- Consumer's retailer (agreement on payments)

A particular difficulty is the requirement to reach a bilateral agreement on schedule exchange and compensation payments with the consumer's BRP and retailer. There are no standards for this, and the BRP and retailer often have no interest in working with the aggregator to reach such an agreement. The reason for this is that BRPs/retailers usually see the aggregator as a competitor.

An aggregator may work as a service provider to a retailer. In this case the aggregator is pooling loads in one retailer's balancing group. Though it is positive to see Demand Response services offered by retailers, this limitation hinders market growth by lowering competition and limiting the range of customers who can participate within the portfolio of a particular retailer. It also does not take into account retailer's business model challenges with Demand Response (See Introduction).

In the beginning of November 2015, the German government made legislative proposals for a new Electricity Market Act (Strommarktgesetz). Those proposals include changes to section 26 paragraph 3 in the Ordinance on Electricity Network Access (Stromnetzzugangsverordnung - StromNZV) which aim at opening balancing groups by the balancing responsible parties for independent aggregators offering DR services in frequency restoration reserves (FRR) and minute reserves (mFRR). However, the bill still has to pass the parliamentary process and most importantly, the initiation of a subsequent formal regulatory proceeding defining the technical details and market processes lead by the German Regulatory Authority is lacking.

Conclusions

Ancillary service markets are open to aggregated demand in theory, however program descriptions remain generation centric and act as a barrier to participation. For example E.ON and RWE, as well as aggregators and large consumers, have voiced frustration over these designs, but with relatively moderate results. Independent aggregation is not possible due to the requirement that the aggregator gains the permission of the BRP/retailer prior to contracting with a consumer. There is no standardised process in place to enable the role of independent aggregator in Germany.

Main Market Enablers

- **In theory, market is open:** Ancillary services are open, it is legal to bid in aggregated load.

- **Technical modality:** Minimum bids for all balancing programmes have been downsized in 2011 and 2012, making them more accessible for Demand Response.[65] Minimum bids do not exceed 5 MW, except for the Interruptible Load programme where the threshold is still set at a prohibitive 50 MW.[66]

Main Market Barriers

Germany has many remaining barriers to Demand Response:

- **Roles and Responsibilities** do not enable independent aggregation:

[65] 50Hertz/Amprion/TransnetBW/TenneT (2015): Minute reserve, available at: https://www.regelleistung.net/ip/action/static/ausschreibungMrl (retrieved on 18th April 2015)
[66] 50Hertz/Amprion/TransnetBW/TenneT (2015): ibidem

- No standardised process has been put in place to enable independent aggregation. An aggregator must have a bilateral agreement from its potential competitor, the BRP prior to engaging with a consumer.

- **Network Fees** penalise many large consumers for changing their load profile either up or down. These penalties remove the benefits of Demand Response for the consumer and block participation. Austria had similar structures in place but succeeded in removing them in 2014.
- **Technical modalities** are inappropriate and remain generation centric. These includes:
  - Reserve power requires the ability to be activated for a duration of 4 hours for Minute Reserves and 12 hours for Secondary Reserves (up to 60 hours over the weekend), whereas the service is normally only required for much shorter periods and the reserve power concept foresees secondary reserve to be replaced by minute reserve within much shorter timeframes. Markets such as Austria, Belgium, the Nordics, and the UK have lowered the required activation period in order to allow demand-side resources to compete.
  - **Interruptible Loads (AbLaV)** The minimum bid size of 50 MW, a prohibitive limitation. Very rigorous requirements on the consumption profile allow only a few **seconds** of deviation per month, creating significant entry barriers for consumer participation.
- **Technical Modality - Pre-qualification**
  - Tests are required at an **individual** asset level, a significant barrier to consumer participation as each small consumer site is treated as if they were a 500 MW generation unit. This significantly limits participation, as many loads/assets that would provide valuable contributions to a pool through their specific capabilities cannot pass the pre-qualification stage on their own. Given that it is the pool delivering the services to the TSO, it should be the pool that is pre-qualified, not the individual assets/loads within the pool. Many neighbouring countries have moved to pool-level pre-qualification, such as France, Switzerland, Austria, Finland, Denmark and Sweden.
  - The pre-qualification process may take many months, or in extreme cases up to a year at times when TSOs have limited resources to deal with (sometimes large amounts of) pre-qualification requests. This unpredictability makes it challenging for consumers and their service providers to develop a reliable business case.

United Kingdom

Great Britain (GB) was the first country to open several of its markets to consumer participation in Europe. Today, all balancing service markets are open to Demand Response and aggregated load is accepted. However, unfortunately in recent years it seems that the stakeholder process between providers, DECC and Ofgem has not been as effective as would be hoped in a mature market. As a result, measurement, baseline, bidding and many other procedural and operational requirements are still inappropriate for demand-side resources, noticeably reducing the number of demand-side MWs in the system (even as national capacity continues to decline). Therefore, though the markets remain open in name, the actual results are worse in 2015 than 2013-14. If the trend continues the UK will no longer be a viable market for Demand Response providers.

The BRP and Aggregator issue is not yet resolved in GB. However, as the aggregator is not required to contract the retailer/BRP directly, this lack of clarity has not yet had an adverse impact on the market. In future, it will be important to clarify this relationship for the fairness of all involved – including the retailer/BRP and also in order to open the wholesale and balancing markets.

The Capacity Market, introduced at the end of 2014, does not place demand-side resources on an equal footing with generation. In fact, only one demand-side aggregator, of the approximately 15 in the market, secured a contract within this new market in the first Capacity Market auction.

As National Grid is under growing 'distress' because of the growth of embedded generation, interconnection and large transmission-connected renewables, and also DNOs encouraging more innovative products, the opportunity for Demand Response is in principle higher than ever. However, due to poor policy development and design choices, that opportunity cannot be realised.

That said, due to the highly competitive retail market and the multiple small aggregators, at least 2 of the aggregators have recently taken out supply licences. One new retailer, Tempus Energy, is building their internal balancing processes **using** Demand Response (they therefore balance their portfolio with flexible load rather than flexible generation). Tempus are the first of their kind, a new and very interesting development. **If** these small new ventures are successful – it could be an important development. Not all consumers are appropriate for Tempus' portfolio because not all available loads are flexible. Nevertheless, it demonstrates the results of lowering entry barriers and encouraging market momentum.

Status of technical modalities and market opening

All ancillary services markets are open to Demand Response, however as substantial market entry barriers appear in almost every market, consumer participation has **fallen** over the last 2 years. Aggregation is possible in all the programmes. The only dedicated programme for Demand Response is the Demand-Side Balancing Reserve (DSBR), which was introduced last winter.

Table 10. *Ancillary Services Markets open to aggregated demand*[67]

ENTSO-E's terminology	National Grid's terminology		Tot. Capacity Contracted	Aggregated Load Accepted
FCR	Firm Frequency Response (FFR)[68]	Dynamic	180 MW	*
		Non-Dynamic	0 MW	*
FRR	Fast Reserve Firm Service (FRFS)*[69]	Dynamic	2313 MW	*
		Non-Dynamic	54 MW	*
RR	Short-Term Operating Reserve (STOR)[70]	Committed	2420.6 MW	*
		Flexible	757.7 MW	*
RR	Demand-Side Balancing Reserve (DSBR)		318.7 MW	*
FCR	Frequency Control by Demand Management (FCDM)		Not public	*

[67] Source : SEDC DR Map 2015
[68] All accepted tenders active in January 2015
[69] All accepted tenders active in January 2015
[70] Data for STOR year 8 – weighted average capacity over all 6 seasons

Wholesale Market

Demand Response currently only directly participates in the British Day-ahead and Intraday markets in the form of flexibility of retailers and large industrial customers that are already trading members.

Capacity Market

Aggregated Demand Response has access to the Capacity Market in theory, although in practice participation rules are strongly biased in favour of generation.

Demand Response providers and small independent retailers interviewed also voiced frustration at a lack of full representation during key meetings. For example within the capacity market design committee organised by DECC, meetings took place behind closed doors for over one year. Of the 15 participants there was 1 representative for consumers and 1 for aggregators. The 13 other participants represented generators.

The design of the market, reflected the balance of the group, and consumer participation within the capacity market has proven impossible. For example, new generators are eligible for 15-year capacity agreements, whereas Demand Response providers are eligible for one-year capacity agreements. While generators can bid in resources that they will build in future, Demand Response providers can only bid-in resources that they have already built – meaning that they had to contract with consumers in 2015 for a program that would begin to pay them in 2018. Unsurprisingly, in the T-4 auction, a mere 0.4% of total capacity has been awarded to Demand Response.[71]Another barrier is the mandatory provision of a credit cover for new (i.e., unproven) Demand Response poses a significant barrier to potential participants. A change to regulations, providing longer deadlines for credit cover submissions, is part of the current consultation process.

Short Term Operating Reserve (STOR): The new regulations within the STOR programme strongly devalued the market for consumers and approximately 9-10 aggregators have left. The requirements are challenging for consumers, as they require daily weekday participation, with a window of 11-13 hours per day, in order to be paid at a competitive level. It is possible to choose one time window (morning/evening), but it involves an important devaluation of the resource, lowering revenues. Another significant barrier is the long period of time between contracting a site and obtaining first payments. Demand Response now represents a limited part of this reserve.

A positive enabler: prequalification takes place at the pooled assets level. However signing a STOR framework agreement can take between 2 weeks and several months.

STOR Runway, a new option, will shorten this period, as National Grid will accept tenders for volumes that have not yet been fully “created” and qualified. This allows aggregators to “grow” their pool with financial guarantees, a positive step forward.

Ancillary services Markets

Firm Frequency Response. FFR is open to Demand Response providers. However the minimum capacity of 10MW, in both dynamic and non-dynamic profiles. Dynamic is where generation or consumption output will rise and fall automatically in line with the system frequency. Static is where an agreed amount of energy is delivered if the system frequency hits a certain trigger point e.g. 49.8Hz. **Fast Reserve Firm Service.** The FRFS programme requirements are very stringent, making it difficult for consumers to participate. It requires a 50 MW minimum bid size. Incremental additions are a minimum of 10 MW for each bidding unit. Coupled with a frequency of 10-15 activations per day, FRFS is not an attractive product for Demand Response. **Frequency Control by Demand Management**. The FCDM programme is used to managing large deviations in frequency, such as

[71] Auction results available at: https://www.gov.uk/government/statistics/capacity-market-location-of-provisional-results

those caused by the sudden loss of a large generating unit. There were nine events in 2013 and nine in 2014, always with a maximum duration of 30 minutes. The service is a route to market for demand-side providers, and is entirely managed through bilateral contracts between potential providers and National Grid.

Another issue: Baseline methodologies vary by market and product. No one methodology works for all types of Demand Response, and under current rules, some methodologies favour customer generation over load curtailment.

Triad Charges. Triads, (Transmission Network Use of System) charges – are three half-hour periods on three different days separated by at least 10 days (the triad periods), that electricity demand is at its highest across GB. They were established to recover the cost of installing and maintaining the transmission system in England, Wales, Scotland and offshore. The triad days occur between November and end of February. Customers' average consumption in each network zone over the 3 triad periods is calculated, and then it is multiplied by the triad charge. This gives the total amount that retailers need to pay to National Grid. Customers receiving pass-through charges pay their share based on average consumption during the three highest peak triad periods. Service providers may send triad warnings to their customers about 20-30 times annually, up to one day in advance, by e-mail, text message or other devices in order to warn them of a possible peak triad period. Lowering the triad charges brings good value for load flexibility.

Two new balancing service pilots have been developed to support National Grid in balancing the system and address tightening capacity margins until 2016. The new services are Demand Side Balancing Reserve (DSBR) and Supplemental Balancing Reserve (SBR).

- DSBR is a Demand Response opportunity, targeted at large energy users who volunteer to reduce their demand during winter weekday evenings between 4 and 8 pm in return for a payment However, a very short application period of only 5 weeks in the first tender round for the 2014/2015 delivery period made it very difficult to gather sufficient market intelligence and customer support for this programme, again resulting in a failure to encourage demand side participation
- SBR is targeted at power stations that would otherwise be closed and is close to Demand Response. Capacity margins are expected to tighten after 2016, and National Grid has recently consulted on whether to extend DSBR for two further years. Even if it is extended, it will still be a short term, dead-end opportunity, which does not represent a good bridge to the capacity market.

DSO Programs: Ofgem's approach to incentivising network innovation supports demand-side measures when these are cost-efficient: Under the 'Totex' approach to regulation in distribution price control 5 (2010-15), innovation measures are **treated on a par with capital investment;** Great Britain is the only Member State in Europe with this mechanism in place.

Network Innovation Competitions, especially the Low Carbon Network Fund (about £500m over five years)[72]; The current Distribution Price Control (2015-23), under the new regulatory framework RIIO-ED1, is based on innovation & specific outputs, obliging all DNOs to initiate or adopt Active Network Management. Recently implemented and continuously revised regulation mechanisms create the necessary incentives for network companies to introduce smart grid solutions, a dynamic that helped Great Britain attain thought leadership and become a frontrunner in levels of

[72] Though the Low Carbon Network Fund has had some difficulty in attracting a satisfactory amount of commercially viable projects, partially due to the lack of payments to consumers for providing demand side flexibility.

investments in this sector. As a result, five out of the six DNOs are currently running Demand Response trials.

Regulation surrounding aggregation

Independent aggregation is enabled in GB. The aggregator is not required to ask for permission or to inform the retailer prior to load curtailment and has direct access to consumers. They may aggregate load from all over the country. The consumer, however, is contractually obliged to inform the retailer about intended participation. In the future, these rules will need to be formalised and legislation introduced which allows third-party aggregation while protecting the retailer/BRP from sourcing losses and imbalance payments caused through a Demand Response activation by a third-party aggregator.

Concerning BRP's imbalances caused by load curtailment, the customer has no obligation to maintain a consumption profile and British legislation does not address this issue. Due to the number of incumbent retailers and the relatively low participation of Demand Response in general, Ofgem has so far not seen any urgent need to elaborate such an adjustment mechanism. However, Ofgem has indicated its intention to investigate the BRP and aggregator roles and responsibilities at a later date.

Conclusions

Great Britain offers a range of opportunity for Demand Response and encourages market competition between providers.

Market Enablers

- **Open Markets:** Most ancillary services markets are open to Demand Response
- **Aggregation enabled**: Aggregation and independent aggregators are legal and enabled
    - The retail market is competitive, which encourages competition between providers, including incumbents, independent retailers and aggregators
- **Access to finance:**
    - The EIS financing scheme (The Enterprise Investment Scheme is a uniquely British tax relief mechanism) allows many small companies to gain access to start-up finance – including energy service companies. This alone has had a measurable impact on the dynamism of the UK market. It indicates the important connection between access to finance for small companies and competitive energy markets.
- **DSO related regulation:**
    - The regulation surrounding DNOs encourages innovation and energy efficiency. Again this is unique and is a regulatory structure which could be copied elsewhere
    - The Triade Charges allow consumers to earn off of flexibility. Customers receiving pass-through charges pay their share based on average consumption during the three highest peak triad periods. Service providers may send triad warnings to their customers about 20-30 times annually, up to one day in advance, by e-mail, text message or other devices in order to warn them of a possible peak triad period. Lowering the triad charges brings good value for load flexibility
- **Technical Modalities:**

- The FRR and FRSR both allow demand to participate. National Grid has also been willing to work with aggregation service providers who do not fulfil the 10MW minimum participation size – on a piloting basis. This has enabled and encouraged innovative program development. For example more than one provider has begun to automate the central heating units sometimes available in lower income housing. This is one of the first and only instances of lower income residential housing benefiting from frequency payments. The results have been positive and the participation level is likely to increase.

Market Barriers

- **Biased Market Design:**
  - An open Capacity Market can provide critical investment security to Demand Response resources. However the GB Capacity Market design is biased toward fossil fuel generation. Entry barriers are found at **every level** from the market design and bidding process to the technical modalities. For demand side providers this has meant that their competition, generators, benefit from approximately a 1 billion pound subsidy, to which they do have access. This skews ever market in GB, as Demand Response must always now compete against subsidised resources.
- **Technical Modalities:**
  - Though all markets are open – unlike for example Austria and Belgium, GB regulators and the TSO have not succeeded in maintaining any fully viable entry points for demand side assets and many aggregators and consumers have left the market.
  - Changes within the STOR bidding process and availability requirements significantly lowered the value of the market for demand side providers and encouraged the entry of older generation assets.
  - Baseline and measurement criteria are better suited for back-up generators than demand reductions which lower the environmental benefits of Demand Response and shrinks the pool of available consumers.
  - The 'replacements' for STOR as a means of building demand side capacity, have been non-functional and/or short term. For example the DSBR pilot which as meant to allow demand side resources to improve system security by lowering peak consumption on winter evenings, is only for 2 years. This does not provide sufficient investment stability to create a robust volume of resources. On top of this National Grid allowed only 5 weeks to engage consumers, an impossible and unrealistic goal.

Unfortunately the market barriers have therefore partially undermined the market enablers and British consumers do not fully benefit from the range of programs which in theory should be available to them.

Greece

Greece is still working to liberalise its retail energy prices and complete the deregulation of its market in accordance with the Third Energy Package.

In recent years, electricity prices have risen steeply, in response to the removal of price caps and market liberalisation. This has further stressed an already difficult monetary situation. Due to the severe recession the Greek electricity sector was hit in 2012 by a liquidity crisis. This was created by

several factors, such as unpaid electricity bills, unsustainable support schemes for renewables, liquidity tensions in the Greek banking system and structural deficiencies of the Greek energy market. Both the main incumbent retailer PPC and the market operatory LAGIE SA had accumulated unsustainable debts. These have had to be restructured and prices have risen sharply both for residential consumers and industry[73] between 2012-13 when it seems caps may have been re-introduced for some consumers (the application of rules has been uneven across the country). According the European Commission's report, European Energy Markets 2014, retailers were found to have the second lowest approval rating of any institution in the country. It will be important that consumers are offered services and the ability to better control their costs as soon as possible. However, for the moment the lack of Smart Meters makes this difficult. Efforts have therefore been concentrated on the larger Commercial Industrial customers.

PPC announced plans in February 2014 to cut energy rates for energy-intensive industries including. A discount of 10% on PPC rates benefited companies with high electricity consumption during 2014–15. Companies with annual consumption of over 1,000 GWh received an additional 10% discount. PPC offered a further discount of 25% on its night and weekend rates for industries with annual consumption below 1,000 GWh. The Greek government hopes that the expected loss of some €75 million owing to the discount will be balanced by increased consumption by industrial users

At the same time, they are establishing two Demand Side interruptible programs, to complement their existing Ancillary Services market. These do not as yet allow for aggregation but unlike the programs in Italy and Spain, they will be dynamic, auctioned on a monthly basis and intended for frequent use. Greece is also carrying out a full regulatory review in preparation for a CRM Capacity Remuneration Mechanism, and plans to define aggregation within this framework.

Status of Technical Modalities and Market Opening [74]

The following table shows the electricity market product or sub-products and underlines where Demand Response and aggregation could participate, including related market sizes.

Table 11. *Ancillary Services Markets open to aggregated demand*[75]

ENTSO-E's terminology	TSO's terminology		Market size	Load Access & Participation	Aggregated Load Accepted
FCR	Primary control and reserve		70 MW	X	X
FRR	Secondary control and range	Secondary upwards reserve	400 MW	X	X
		Secondary downwards reserve	100 MW	X	X

[73] European Commission. European Energy Market Country Reports. 2014

[74] All information on the Greek Interruptability programmes is sourced from: SA.38711 (2014/N) Greece - Interruptibility service for the electric system in Greece dated 5 April 2014.

[75] Source : SEDC DR Map 2015

		Fast Secondary upwards reserve	30 MW	X	X
		Fast Secondary downwards reserve	10 MW	X	X
FRR-M	Tertiary control and Spinning reserve		800 MW	X	X
RR	Deviation Management			X	X
	Standing reserve		150 MW	X	X
	Voltage control		2600 MW	X	X
	Black start		N/A	X	X
Interruptible loads		Type 1	1000 MW	*	X
		Type 2	1000 MW	*	X

- **Balancing Markets:** Between the day-ahead settlement and real-time delivery, the Greek TSO instructs units to dispatch in real-time to ensure overall system reliability. This market is not yet open to Demand Response or aggregation.

- **Interruptibility Programs:** There are two interruptibility programs, which have been established and will be launched in 2016. Consumers with 5 MW of flexible load may participate**.** Low Voltage customers might eventually be included in the interruptibility scheme, assuming a positive review by the TSO. However, they will first need to be equipped with smart meters. Participating consumers must register in the Interruptible Load Register in order to be able to participate in the monthly auctions.

- **Baseline Calculations and Payment are Calculated According to:**

  - The maximum hourly measured electricity consumption and in each consumption location during the previous five calendar years.
  - The active power level for which the Consumer vows in the Interruptible Load Agreement that he can safely reduce the active power in the consumption location following the TSO's Power Reduction Order.

Table12. Different types of Interruptibility services, offered by the TSO, depending on the notice time, duration of each load shedding and maximum duration of the load shedding per year[76]

Interruptible Programme	Notice time	Duration of each power reduction order (PRO)	Maximum duration of load shedding per year	Minimum period between 2 consecutive PRO	Maximum period between 2 consecutive PRO
Type 1	2 hours	48 hours	144 hours	1 day	3
Type 2	5 minutes	1 hour	24 hours	5 days	4

The Ministerial Decision sets out two types of services to be procured by the TSO, summarized above. Within the notice period specified for each service, the customer must reduce its electricity consumption to a level lower than or equal to that specified in the Power Reduction Order. The duration of individual load shedding events (and the cumulative duration of all load shedding events per year) cannot exceed predetermined periods for each customer, according to the type of service being provided. Registered consumers comprise the annual list of pre-selected tenderers, allowed to participate in monthly auctions launched by the TSO.

- In any case, the total financial compensation for any one month cannot exceed a limit of €15 per MWh of electricity consumed by the consumer during the month. Applying the cap on the monthly consumption of a consumer is intended to ensure that only consumers that were really consuming energy during a month and thus could actually provide the interruptibility service will be reimbursed.
- Beneficiaries are selected on the basis of uniform price auctions, in which the lowest price bids will be selected, given the volume of each service requested. The price of the bid selected either in full or partially up to the limit of the offered capacity constitutes the marginal price and the uniform auction price.
- Over the duration of the scheme, the amount of interruptible capacity for which the TSO will tender will be capped at **1000MW** for each service.

Wholesale

Load is not accepted as a resource in the Greek wholesale market, even by retailers. This will be reviewed during the development of the CRM (Capacity Remuneration Mechanism).

Capacity Market

The government is carrying out a review in preparation for a CRM. The regulator states that Demand Response participation is one of the key elements in the scheme. Special care will be taken in the design phase, in order to ensure open access of all interested parties to the new scheme, as well as the involvement of aggregators.

Legal framework for aggregators

As of today there is no legal framework for aggregation in Greece. This is still under development.

Conclusions

[76] SA.38711 5 April 2014 (http://ec.europa.eu/competition/state_aid/cases/252671/252671_1597844_91_2.pdf)

The Greek market is still under development and shifting from a regulated to de-regulated system. Issues remain concerning cross subsidies between sectors. The sharp increase in electricity costs during this period has caused further financial pain to the population and business.

For the time being, the TSO has made good progress in creating a market based interruptable program designed to complement their existing reserve markets. When this is expanded further within the CRM this legislation is completed.

Main Market Enablers

- **Technical Modalities:**
  - The baseline methodology is appropriate and realistic – based on consumer capabilities and metering data.
  - The payment criteria are clear.
- **Market Design:**
  - The legislation is fully defined, clear and encourages competition through monthly auctions. Bi-lateral agreements have been avoided.
  - The monthly bidding process allows for consumers to participate during the times of year best suited to their usage patterns.

Main Market Barriers

- **Technical Modality:** The 5 MW limitation is high for a single user.
- **Enable Aggregators.** Aggregation of units is not yet allowed.
- **Closed Markets:** The wholesale and remaining ancillary services market remain closed

Ireland

While balancing market programmes still remain closed to Demand Response, Ireland has seen increasing Demand Response activities in recent years. Having phased out its main Demand Response scheme in early 2013, Ireland's TSO, Eirgrid, is providing incentives to Demand Response providers to enrol as Demand Side Units (DSU). Enrolment makes them eligible for capacity payments in the Single Electricity Market (SEM). The first DSU became operational in July 2012; the second in December 2012.

With a rapid expansion of wind energy and a target of 40% renewable energy in electricity generation by 2020, the system's need for flexibility is set to increase in the following years. Further business opportunities will be created with the opening of the balancing markets for DSUs.

In fact, the lack of consumer access to ancillary services markets today is surprising. Ireland has quite severe issues with frequency due to a lack of interconnection with other markets and high levels of inflexible generation assets (such as wind). For example it was representatives of the Irish TSO in ENTSO-E, who proposed all consumer appliances should be frequency sensitive (without consumer choice or information) and worked to drive this legislation through within the European Network Codes. To justify this extreme measure they pointed to the difficulty of maintaining frequency in Ireland and the eventual issues elsewhere in Europe. Yet the frequency markets, remain shut to paid consumer engagement for the moment, though this should change within 2016-17.

The Commission for Energy Regulation and the Utility Regulator of Northern Ireland are currently developing an Integrated Single Electricity Market (I-SEM), intended to be implemented by late 2017. The detailed design is still under consideration, but they have settled on a volume-based capacity market, using reliability options. The I-SEM will replace many of the structures described

here. The result could be better or much worse for Demand Response than the status quo, depending on some of the elements of the detailed design, which have not yet been decided.

Status of technical modalities and market opening

A DSU consists of one or more individual Demand Response sites that can be dispatched by the Transmission System Operator (TSO) as if it was a generator. Individual Demand Response sites may be aggregated to be operated as a single DSU. Eirgrid issues dispatch instructions at an aggregate level and the DSU aggregator then coordinates the reduction from the individual Demand Response sites. By being available for dispatch, the DSU will be eligible for capacity payments in the Single Electricity Market (SEM) while other ancillary services markets remain closed.

Table 13. Ancillary Services Markets open to aggregated demand[77]

ENTSO-E's terminology	Eirgrid's terminology		Tot. Capacity Contracted	Load Access & Participation	Aggregated Load Accepted
FCR	Primary Operating Reserve		Not available	✗	✗
FRR	Secondary Operating Reserve		Not available	✗	✗
RR	Tertiary Operating Reserve		Not available	✗	✗
RR	Replace-ment Reserve	Synchronised	Not available	✗	✗
		De-Synchronised	Not available	✗	✗
Interruptible loads	STAR		Not available	*	*
Price-based capacity provision	DSU		7,046 MW[78]	*	*

Balancing Market

Ancillary services are still closed to Demand Response. A multi-stage consultation process through a review of System Services has been completed by the TSOs and the regulators are analysing recommendations. In its recommendations to the regulator, Eirgrid proposes that the services should be technology-neutral. New products are expected as well: ramping margins would be maintained to counter wind volatility by procuring Ramping Capacity.[79] At the moment, the results of this consultation process are expected to enable Demand Response in the Balancing Market by 2017.

Wholesale Market

Demand Response participates in the wholesale electricity market from the point of view of bidding and dispatch, however Demand Response providers do not earn an energy payment for this. Participation in the wholesale market is required to earn capacity payments in the capacity market. This is in clear contradiction to generation, which earns energy payments from providing supply side resources in the wholesale market and is not expected to participate for free.

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[77] *SEDC 2015, Demand Response Map*

[78] CER (2014a): Total Capacity requirement for 2015, available at: http://www.allislandproject.org/GetAttachment.aspx?id=229e36bd-411a-4a88-8140-f0a43068ad70 (retrieved on 20th February 2015)

[79] For a description of these products, see: Eirgrid/SONI (2012): "DS3: System Services Consultation – New Products and Contractual Arrangements", available at: http://www.eirgrid.com/media/System_Services_Consultation_Products.pdf, p. 25-27. (retrieved on 24th March 2015)

Interruptible Contracts. Eirgrid's STAR scheme provides short-term reserves to the transmission grid, using under-frequency relays at industrial sites. Providers of this service can expect 10 to 20 unplanned and instantaneous interruptions per annum typically of the order of 5 minutes duration.

Capacity Market

A volume-based capacity market does not yet exist in Ireland. Ireland has established a price-based capacity provision in the wholesale market, with a fixed cap of total payments being split across the year into each half-hour window. Prices per half-hour vary throughout the year, and eventual payments are then split between all capacity providers that subscribed their capacity for this particular half-hour. There is 80% accuracy in upfront capacity calculations, with wind forecasting having the strongest influence on uncertainty.

The individual units of each pool of loads have to fulfil all technical and prequalification requirements. Therefore, aggregators are not able to shield consumers from these technical and difficult prequalification procedures: each consumer is treated as if they were a large generation unit. This is a critical barrier to consumer participation as it forces providers to go through onerous technical pre-qualification measures, which they may not have the ability or knowledge to fulfil. This prequalification is also very costly and might even get worse in the years to come, with the opening of the balancing market programmes to Demand Response. Prequalification should be carried out at the pooled level to avoid this issue.

An Irish Aggregator states: *'Ireland exhibits a common problem with its product design for participation in the capacity mechanism: technical requirements, which are more onerous than strictly necessary. When only a small number of large power stations were participating, the costs were not material, so this didn't really matter. Now that those same requirements are being applied to large numbers of much smaller customer sites, they have become highly significant. One such requirement in Ireland is the need for continuous telemetry from every site, with a maximum latency of 15 seconds.'*

Once they have filled the Demand Side Unit (DSU) requirements, consumers or aggregators are treated like generators in the market. DSUs that are available for demand reduction are eligible for a capacity payment in the Single Electricity Market (SEM). They bid in prices and quantities for demand reduction and receive availability payments[80]. However, DSUs do not receive an utilisation payment. About €530 million was available in total in the capacity market in 2013 for availability payments. The Energy market is valued at €2.1 billion. [81] Aggregators must provide a minimum of 4 MW bids, but there is no minimum size for individual units in the pool.

As of today, a meter-before/meter-after system is used and no common baseline methodology has been agreed upon. This is inadequate. Nevertheless, a group has been created to discuss the issue in cooperation with the TSO.

DSO: An aggregator must obtain the permission of a customer's DSO before that customer can provide ancillary services to the TSO. In principle, this seems a reasonable requirement. In practice, however, it can cause problems, because the DSO has no incentive to take a balanced attitude to the benefits and risks of customer participation. This has been a particular issue in Northern Ireland, where the DSO has introduced an exhaustive approval process and indicated that they will refuse many such requests, or restrict participation to particular times of day or particular seasons, based

[80] The payments are based on 'value' of capacity (month, trading day and trading period). Payments are given for each ½ hour of every day (assuming availability) and vary significantly for a given trading period - from zero to €181.
[81] SEM-O (2013): SEM Market Overview, July 2013, available at: http://www.sem-o.com/Publications/General/SEMO%20Market%20Overview.pdf (retrieved on 20th March 2015)

on what appear to be unjustifiable fears of vanishingly improbable circumstances. In addition, they have indicated that the approval process would have to be repeated if the customer transferred from one aggregator to another, even though this would make no difference to the physical events.

Distribution network

Currently there is not much activity on the distribution network level. However, this is likely to change in the near future with strong involvement expected from DSOs.

Rules concerning aggregators

The SEM is currently an ex-post settled market or centrally dispatched. Retailers do not take a position in advance and are not a BRP. All energy is settled ex-post. Therefore, the sourcing issue for retailers does not exist. The aggregator works as a service provider for demand sites gathered to fulfil the DSU requirements. He does not have to ask for permission or to inform the retailer or BRP prior to load curtailment. The aggregator can aggregate load from anywhere in the country. They are treated as a part of the consumer's unpredictable behaviour.

Neither the BRP nor the aggregator is charged for the imbalances caused by the load curtailment. The Irish electricity market is centrally dispatched, which means that the imbalances are covered by the TSO. When Demand Side Units are dispatched by the TSO, the demand site retailer has avoided costs (imperfections, capacity charges, Mechanism Operated Contacts) for the demand reduction quantity.

Conclusions

Main Market Enablers

- **Investment Security:**
  - The capacity payments within the capacity market support investment security and consumer engagement.
- **Aggregators enabled:**
  - The fact that Ireland is centrally dispatched removes the need for the retailer and aggregator to interact directly, or for a standardised process or BRP-Aggregator payment mechanisms to be put in place. This significantly lowers entry barriers for aggregators.
- **Technical Modalities:**
  - The minimum bid size of 4 MW and the permission of aggregation for DSUs is high for such a small market but allows Demand Response participation (a minimum of 1 MW would be a significant improvement over the current 4 MW requirement).
  - The STAR scheme has no minimum bid size, making it very accessible for consumption units.

Main Market Barriers

- **Closed Markets:**
  - The ancillary services markets, the balancing market, and the wholesale market, are still closed to Demand Response and to aggregation.
- **Technical Modalities:**

- The prequalification process for DSUs has to be fulfilled on an individual asset level at a significant added cost. Prequalification should take place at the pooled level and the role of the aggregator should be respected as in GB, France, Denmark, Sweden, Finland..
- The mechanism involved in the quantification of value within the capacity market is complicated and could be made more transparent.
- The requirement for continuous telemetry from every site, with a maximum latency of 15 seconds.

- **DSO Issues:**
  - In Ireland (Germany and Belgium), an aggregator must obtain the permission of a customer's DSO before that customer can provide ancillary services to the TSO. In principle, this seems a reasonable requirement. In practice, however, it can cause problems, because the DSO has no incentive to take a balanced attitude to the benefits and risks of customer participation.
  - In Northern Ireland, where the DSO has introduced an exhaustive approval process and indicated that they will refuse many such requests, or restrict participation to particular times of day or particular seasons, based on what appear to be unjustifiable fears of vanishingly improbable circumstances.
  - In addition, they have indicated that the approval process would have to be repeated if the customer transferred from one aggregator to another, even though this would make no difference to the physical events.

Italy

Context

In recent years, the electricity market has been characterized by rapid growth of renewable generation and by a decrease of electricity consumption. Italy relies mostly on hydro and gas for its flexibility needs, while the frameworks for Demand Response participation in the ancillary service market, the balancing or the wholesale market, are not yet in place. The only exception is the interruptible contracts programme, which is a dedicated Demand Response programme separate from the balancing market.

The enrolment of interruptible loads is currently about 4 GW, with a minimum size of 1 MW to participate. Aggregation is not allowed. The payments are attractive and related mostly to availability payments rather than real utilisation. The programme has been called very few times during the last decade. In fact it is unclear if it has ever been activated.

Flexibility can access the day-ahead market, but only as demand bids with indication of price, through the retailer/BRP.

The possible opening of balancing products to demand-side resources could lead to an increase of load participation. The potential progress is reflected in the strategic guidelines for the period of

2015-2018, in which the Italian NRA (AEEG) included the evaluation of demand-side mechanisms, for further market development[82].

Markets open to Demand Response

The following table shows the electricity market product or sub-products and underlines where Demand Response and aggregation could participate, including related market sizes.

Table 14. *Ancillary Services Markets open to aggregated demand*[83]

ENTSO-E's terminology	TERNA's terminology		Market Size	Load Access & Participation	Aggregated Load Accepted
FCR	Primary Frequency Control		1,5% of the total installed power	✗	✗
FRR	Secondary Frequency Control		4,77 TWh[84]	✗	✗
RR	Tertiary Reserve		8,99 TWh	✗	✗
	Interruptible (Mainland)	Fast	3.300 MW	* 3.300 MW	✗
		Emergency	0 MW	* 0 MW	✗
	Interruptible (Islands)	Fast	389 MW Sicily 372 MW Sardinia[85]	*389 MW Sicily 372 MW Sardinia	✗
	Capacity Market		Not yet defined	?	Not yet defined

Balancing Market

Market participation is not yet allowed for aggregators or Demand Response.

Primary Frequency Control is an uncompensated service, mandatory for non-intermittent generators bigger than 10MW[86]. **Secondary Frequency Control** and **Tertiary Reserve** are paid services, but not open to load curtailment. The NRA considered starting by the end of 2015 identifying market entry barriers and possible changes in the programmes in order to enlarge participation. In this context, load participation could be evaluated, though this remains unclear. The possible participation of demand-side resources would require a control centre operating 24/7, which is a market entry barrier. The rules regarding verification and definition of baseline are not explicit yet.

[82] AEEG (2014a): "DCO 528/2014/A, consultation document", published on 30 October 2014, available at: http://www.autorita.energia.it/allegati/docs/14/528-14.pdf
[83] *SEDC 2015, Demand Response Map*
[84] AEEG (2014b): "Report 428/2014/I/eel, annex A", of 7 August 2014, art. 9.1, 2013 values, available at: http://www.autorita.energia.it/allegati/docs/14/428-14.pdf
[85] Terna (2013): Action results for the period 2013-2015
[86] Terna: "Allegato A15 Codice di Rete, Partecipazione alla regolazione di Frequenza e frequenza-potenza (Grid Code, Annex 15, Participation to frequency and to frequency-voltage control)", art.4, available at: http://www.terna.it/LinkClick.aspx?fileticket=TwRReqwHbvk=

Interruptible Contracts. The participation is allowed for consumers with a minimum available curtailment potential of 1 MW for each site[87].

Interruptible Loads, managed by the Italian TSO (Terna), are trigged after a TSO's order and have to react almost instantly (200 ms). Some conditions vary between mainland Italy and insular Italy (Sicily and Sardinia). Specifically, in mainland Italy, all the capacity has been already contracted for 3 years, starting from 2015. New entrants are only provided access in case of some participants' withdrawal.

Aggregation is not allowed.

Participation is allowed for Consortium or community owned utility, which is a legal association of private companies or public bodies (i.e. agricultural associations, associations of public bodies, etc.)[88]. In that case, the Consortium manages all the energy needs for the group. Only two Consortiums were awarded for the 2015-2017 tender[89].

This program is rarely called and could be seen as a form of state subsidy for large industry. In fact, when the regulator has looked to open the market and allow in real bidding and aggregation, there has been some resistance on the part of these large consumers, as they are concerned they could lose this revenue stream in a competitive and open market.

Wholesale Market

Large industrial consumers can access the spot market in a single or aggregated form (as dispatching user), with demand bids with indication of price as part of their supply contract[90]. The participation is low as entry is difficult and very little activity takes place. The context of raising economic constraints could explain a small increase in the last few years. Participants entered offer for 46,5 TWh in 2013 of which only 5,9 TWh were accepted.

In the Spot Market, consumers should belong to the same market zone[91], and bid a minimum of 1 MWh. The participation fee is € 7.500, for the registration to the platform, and €10.000 as yearly fee, plus some variable costs over the electricity traded[92]. Therefore, the cost of entry is high for a single consumer and aggregation is not allowed.

Capacity Market

In 2014, the NRA approved a new regulation for the capacity market in order to replace the previous temporary framework[93]. The tender-based market will be administered by the TSO. In this regulation, the NRA underlined that the demand-side resources should be able to access this market from the first auctions. The final rules would have to be closely monitored to prevent any form of prejudice to demand-side resources.

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[87] Terna (2015a): "Regolamento per l'approvvigionamento a termine delle risorse interrompibili istantaneamente e di emergenza nel triennio 2015-2017 (Regulatory framework for the period 2015-2017)", art.2, available at: http://www.terna.it/linkclick.aspx?fileticket=6Df1L3TCJsA%3D&tabid=663

[88] Terna (2015), ibid.

[89] Consorzio Lattiere Virgilio Soc. agr. (agricultural) with 2MW, and Consorzio Toscana Energia Spa. (public bodies of Tuscany Region) with 211MW, Terna: "Auction results Fast Interruptible Contracts, period 2015/2017", Ibid.

[90] Italian electricity market is divided into 6 market zones: North, Central North, Central South, South, Sicilia and Sardinia.

[91] Italian electricity market is divided into 6 market zones: North, Central North, Central South, South, Sicilia and Sardegna

[92] GME (2015): "Corrispettivi (Fees)", available at: www.mercatoelettrico.org/en/Mercati/MercatoElettrico/corrispettivi.aspx (retrieved on 15th April 2015)

[93] Ministry of Economic Development (2014): GU 158/2014, 10 July 2014 (Italian Official Gazette), Decree 30 June 2014

DSO Programs

As in most European countries, programmes run by the DSOs are still limited or in a pilot phase. Some pilot projects seek to evaluate the potential of Demand Response at DSO level.

Rules Concerning Aggregators

Demand Response does not have access to the markets and aggregation is not enabled. In the specific case of Interruptible Load Programme, to participate, a consumer is required to be a BRP or have an agreement with a BRP (*dispatching user* in that case)[94].

Conclusions

Italy is in the process of performing a regulatory review. The TSO is concerned by increasing issues with frequency and system security and is searching for demand side solutions. The regulator is also aware that the current rules are not compliant with current EU regulation. They also want to see their market brought in line with the developments in other European Member States. Assuming this review is productive we can expect to see changes within the next 2-3 years in Italy.

That said, they may continue to face resistance from existing large consumers who are adapted to receiving the availability payment through their interruptible contracts, without significant participation in the market.

Main Market Enablers

- The largest consumers are able to act directly and they receive a payment for contracting directly with the TSO and signing an interruptible contract.
- Very large consumers can also participate directly in the Spot Market if they wish to pay the €17,000 upfront fee and €10,000 annually thereafter.
- The best aspect of the market today is that the TSO, DSO and the regulator are aware of the issues and a thorough review is underway.

Main Market Barriers

- Demand Response and aggregation is not enabled within the Italian ancillary services, balancing market or wholesale market.
- The interruptible contracts for large consumers are not a full Demand Response program, they are rarely activated.

Luxembourg

Context

Luxembourg is almost 100% energy dependent, there are very few generators, and therefore Luxembourg has very strong interconnections with the neighbouring countries. These facts have a major blueprint on local generation, electricity grid and consequently on the possibilities for Demand Response.

[94] Terna (2015c): "Contratto tipo per la regolazione del servizio di interrompibilità istantanea (Framework Interruptible Loads)", premise (j), available at: http://www.terna.it/LinkClick.aspx?fileticket=79I33oECozE%3D&tabid=106&mid=468 (retrieved on 15th April 2015)

Market participants

The Institut Luxembourgeois de Régulation (ILR) is the National Regulatory Authority. Besides electricity, ILR is also responsible for regulating other sectors such as the telecoms and postal sectors. As an electricity and gas NRA, ILR is also responsible for network access and pricing, cross-border cooperation, monitoring investment plans and monitoring the function and transparency of the energy markets ((DG ENER) 2014). It also the mission of the NRA to support Demand Response and to put it on equal footing with generation (JRC 2015).

The electricity market is not fully unbundled, because Luxembourg has asked for an exception based on Article 44(2) of the Electricity Directive. Therefore, Creos Luxembourg S.A (the transmission and distribution system operator), five distribution system operators (DSOs) and one industrial system operator (ISO) manage the grid jointly ((DG ENER) 2014).

Markets open to consumer participation

Legally, Demand Response, as well as aggregators are eligible to participate in any of the electricity markets, and theoretically the NRA does not distinguish between the eligibility of generation and demand management. However, in effect, no DR takes part in the market and a change in this is not foreseen (JRC 2015).

Balancing Market

The situation in Luxembourg is particular due to its small size and lack of generators. The balancing market is fully integrated with Germany, whereas Germany performs all balancing activities, based on a bilateral contract between the German and the Luxembourgish TSOs. The same prices and rules apply to the local BRPs as to the German counterparts. The integration is in line with the European aspirations for internationally interconnected grids.
There are BRPs in Luxembourg, however BSP does not exist. For demand to participate in the market, the Luxembourgish BSP would have to apply to the German TSO, however this procedure is not established. There is no platform and the IT solutions have not been set up. The TSO has studied the costs and benefits and found that the costs to create such a platform are too high compared to the DR potential. It is currently under discussion whether there should be an explicit incentive both to generators and demand flexibility providers to encourage participation in the balancing market.

Wholesale Market

There is currently no national power exchange or spot market for electricity, but the absence of congestion on interconnectors means wholesale operators can participate on other power exchanges, such as the European Power Exchange SE (EPEX SPOT SE), both in the day-ahead and the intra-day markets. Therefore, the same rules, practices and barriers apply as in Germany (see the chapter on Germany).

Status of regulation concerning demand response

The Energy Efficiency Directive Art. 15 was transposed on 19 June 2015 through the Act of 1 August 2007 concerning the organisation of the electricity market and the Act of 1 August 2007 concerning the organisation of the gas market (JRC 2015), following a long legislative procedure (Ministry of Economy 2014). According to the law, DR is allowed on all markets, including balancing, wholesale and ancillary markets.
Article 20, new paragraph 5 of the amended Act concerning the organisation of the electricity market requires that calculation methods for network tariffs contain incentives for network operators so that they can provide services to network users permitting them to implement energy efficiency measures in respect to the development of smart grids. In this respect, the network

operators must take into account the cost-benefit ratio of the individual measures (Ministry of Economy 2014). Furthermore, Art. 20, new paragraph 1 requires that demand response and other energy efficiency improvements are enabled by network tariffs. Network tariffs must also reflect cost savings in networks achieved from demand-side and demand-response measures and distributed generation (including savings from lowering the cost of delivery or network investment and a more optimal operation of the network).
Network operators must treat suppliers of demand response services in a non-discriminatory manner, on the basis of their technical capabilities and subject to the technical constraints inherent in the operation of their networks (Art. 27, new paragraph 7).
The regulatory authority must encourage the participation of demand-side resources, such as demand response, in the wholesale and retail markets to the same extent as supply-side resources (Art. 54(2), new subsections u) and v)). The regulatory authority must also support access and participation of demand response in balancing, reserve and other system services markets. To do this, the regulatory authority must define the technical modalities for participation in these markets.

Smart meters and smart grids

A mandatory smart meter roll-out by 2016 was decided in 2012, which was postponed lately to 2020. The costs are integrated into the network tariffs. This will allow the application of time-of-use tariffs. In this future model, small consumers will contract retailers

Conclusions

Demand Response is not used in Luxembourg. The legal basis has been established, including the eligibility of aggregators, however, as a result of the particularity of the Luxembourgish electricity system, a practical implementation has not followed.

Main markets enablers

The future integration of Demand Response is prepared via the established legal basis and a possible consideration of increasing the balancing power locally through the use of local load management. At the moment this inspiration is not adopted.

Main market barriers

The market is mainly limited because of the lack of the technical and procedural solution to join into the German market. The contract between the German and Luxembourgish TSO fully serves the needs for balancing the national electricity market.

The Netherlands

Context

The Netherlands presents an interesting model, as the TSO has succeeded in enabling a significant amount of demand-side flexibility with relatively simple market structures, namely clear and timely price signals – particularly to green-house owners. This is positive and offers an opportunity to enable further market development through encouraging market competition between service providers.

Tennet, the Dutch TSO, estimates that currently up to 1 GW of flexibility (including generation assets) may be present in the Dutch market. The total volume of balancing energy activated by the TSO per year presently stands at 500 GWh.

The balancing market plays a central role in the Dutch electricity system. The main drivers for demand-side participation is imbalance management of BRPs for their own portfolios and so-called

"passive balancing", which presents the advantage of simplicity, but prevents third-party aggregator to access consumers directly.

Status of technical modalities and market opening

The table below gives an overview of the programmes used by Tennet in order to balance the Dutch network:

15. Table *Ancillary Services Markets open to aggregated demand*[95]

ENTSO-E's terminology[96]	TSO's terminology	Tot. Capacity Contracted	Load Access & Participation	Aggregated Load Accepted
FCR	Primary Control (*Primäre Regeling*)	Weekly procurement	✗	✗
aFRR	Regulating Capacity (*Regelvermogen*)	300 MW, yearly procurement; Additional voluntary bids per ISP (15 mins)	*	✗ (portfolio product, presumably no load involved)
mFRR	Reserve Capacity (*Reservevermogen*)	Voluntary bids only, per ISP (15 mins)	*	*
mFRR	Emergency Power (*Noodvermogen* + *Omgekeerd Noodvermogen*)	350 MW[97] + 150 MW, yearly procurement	*	✗ (>230 MW industrial load and aggregated resources)
RR	Replacement Reserves	Traded on the intraday market		

The largest share of demand-side flexibility is used in "passive balancing/passive contribution". It is based on voluntary contributions from BRPs to balance the grid, without being actively selected via a bidding ladder. This structure is unique to the Netherlands and therefore not easily repeatable in other Member States.

In case of a short or long market, the BRPs can be **rewarded** for their imbalance – instead of being penalised, as it may happen in other countries, **if** their position contributes to the balancing of the whole network. **Such a solution is possible due to publicly available near real-time imbalance positions and prices**[98]**.** The BRP's aggregators typically pool demand-side resources from greenhouses, hospitals, small industries with CHP and load shedding capabilities, which react to these prices often through automated controls.

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[95] *SEDC 2015, Demand Response Map*

[96] Elia (2014): "Potential cross-border balancing cooperation between the Belgian, Dutch and German electricity Transmission System Operators", p. 4, available at: http://www.elia.be/~/media/files/Elia/users-group/141008_Final_report.pdf (retrieved on 14 March 2015)

[97] Energie Keuze (2014): "Tennet zoekt nieuwe leverancier noodvermogen na wegvallen 100 MW", available at: http://www.energiekeuze.nl/nieuws.aspx?id=1926. (retrieved on 14 March 2015)

[98] "*In the Dutch imbalance management system control area imbalance positions and imbalance price are made public in near real-time. Therefore all market participants have the opportunity to voluntarily contribute to the TSO's efforts in maintaining the system balance. This so called 'passive contribution' is believed to result in a substantial reduction in the required control energy.*" TenneT (2011): "Imbalance Management TenneT Analysis report", p. 14, available at: http://www.tennettso.de/site/binaries/content/assets/transparency/publications/tender-of-balancing-power/imbalance-management-tennet---analysis-report.pdf (retrieved on 15 March 2015)

Balancing Market and Ancillary Services

Demand Response and aggregation are allowed in Frequency Restoration Reserves (FRR) – automatic and manual (it includes Regulating, Reserve and Emergency Power), and in Replacement Reserves. Primary Control does not allow load access and aggregation. **FCR.** Primary Reaction is tendered on a weekly basis. The participants should have a framework agreement signed. It is a symmetrical product and therefore blocks most demand-side units from participating. **aFRR.** Regulating Capacity is contracted through yearly procurement, and spontaneous bids are also possible. The minimum size of a bid is 4 MW. Submitted bids are selected in a common merit order. **mFRR.** Reserve Capacity is procured through voluntary bids. It is divided into Reserve Capacity for balancing purposes and for other purposes; the latter serves for re-dispatch and is not a part of balancing market. In the **Regulating/Reserve Power** scheme, large electricity consumers (> 60 MW) are required to make their flexibility resources available to the TSO[99]. All other parties can do so on a voluntary basis. Bidders are free to state the conditions for activation. These include automatic activation or scheduled products, activation time and bid price. The TSO then accepts the bids according to its needs. **Replacement Reserves** are traded on the intraday market; they are not activated by the TSO. In 2013, 48% of the total Dutch load was traded via Power NL Day-Ahead Market[100].

Network Congestion Management

The programme, introduced by Tennet in 2008, aimed to distribute limited amounts of transmission capacity. In case of expected congestion, a participant (generator) could offer to refrain from injecting electricity into the grid in exchange for payments. However, the programme is not currently active and does not include the possibility for consumers to reduce consumption for the same payment.

Emergency Capacity

Noodvermogen is contracted annually via tenders in May/June. Since 2014, it is procured separately for downward and upward regulation, allowing consumer loads to participate. The contracted volume has to be provided within 15 min., and shall be available nearly 24/7 (required availability amounts to 97 – 100%). The minimum contracted volume is 20 MW[101], and it can also come in an aggregated form[102]. The Emergency Capacity is therefore difficult to enter for new entrants as the 20 MW minimal load required acts as a significant barrier to participation.

Wholesale market

The wholesale market is a portfolio market for buying and selling energy. Demand Response offers can be bided into the wholesale market through the retailers' supply contract.

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[99] Tennet (2012): "Implementation Guide", available at: http://www.tennet.org/english/images/120214%20SO%20SOC%2012-xxx%20Uitvoeringsregels%204%202%20%20UKclean_tcm43-19026.pdf (retrieved on 14 March 2015)

[100] APX Holding BV (2014): "Annual Report 2013", p 11, available at: http://www.apxgroup.com/wp-content/uploads/APX-Group-Annual-Report-20131.pdf (retrieved on 15 March 2015)

[101] Tennet (2013): "Memorandum to Retailers Emergency power", available at: http://www.tennet.eu/nl/fileadmin/downloads/About_Tennet/ENGELS-SO-SOC_13-056_Productinformatie_noodvermogen.pdf (retrieved on 13 March 2015)

[102] Tennet, "Noodvermogen", available at: http://www.tennet.eu/nl/fileadmin/downloads/About_Tennet/Publications/Other_Publications/plugin-120521_Brochure_noodvermogen_tcm43-20672.PDF (retrieved on 14 March 2015)

DSO Programs: There are few experimental projects run by DSOs, focused on electricity storage or use of smart technologies.

Rules governing aggregation

In the Netherlands, competition over demand-side services is not enabled. The offering is always bundled with the sale of electricity and by a BRP (the non-competitive portion of a Retailer). Consumers must either reject the entire service or accept the aggregator's/BRP combined offer, or try to re-negotiate their entire retail contract with another retailer in order to access the Demand Response services they required.

Aggregators in the Dutch Market offer portfolio optimisation services to BRPs only, through trading on the day-ahead, intraday and balancing markets. BRPs optimise imbalances through real-time dispatch and may act as balancing service providers. BRPs can act as aggregators or they can hire a third-party aggregator for this service.

In this context, a third-party aggregator is obliged to have an agreement with the consumer's BRP and with its retailer. The aggregator can only work as the BRP's service provider. As in other Member States, this creates a market entry barrier for new entrants.

The pooled load has to fulfil requirements as an aggregate. This is a critical enabler of Demand Response as it allows the BRP-aggregator to act as mediator for the consumer, protecting them from onerous technical pre-qualification measures, which they may not have the ability or knowledge to fulfil.

Baseline settlement depends on the contractual relationship between the end consumer, its BRP and its retailer. The absence of standardised requirements can act as a barrier as each contract must be negotiated individually. For TSO contracted FRR (manual) the BSP is required to supply measurements directly to the TSO[103]. The data regarding actual baselines is only required for a FRR (continuously, 4 seconds-based) and Emergency Power (checked ex post, taking into account the values 1 hour prior to activation to 1 hour after deactivation, with 5 min metering resolution).

Conclusions

In reviewing the Dutch market, **one unique structure,** is the engagement of significant **commercial** capacity in the balancing market. This is made possible by immediate communication of dynamic prices from the balancing market, and the fact that BRPs are rewarded for being 'out of balance' when this helps the position of the overall market. Neither of these elements are present together in other Member States and may be difficult to replicate as they involve regulation government balance responsibility. However, for the green-house industry, this seems to have been a good model.

Main Market Enablers

- **Market Structure:**
    - The real-time prices in the balancing market within the passive balancing/passive contribution option.

[103] Metering is a liberalised market in the Netherlands; the meter data is managed by the meter data manager. The required metering equipment for important connections (superior to 3 * 80 A) is a telemetric meter, with (at least) 15 minutes resolution. For smaller connections there is no such obligation; allocation of realized volumes will then be based on profiling.

- The rewards to the BRP for being out of balance in a direction that supports the market. (This allows BRPs to work more closely with consumers without concern that they will over-respond to a high prices for example, and push them out of balance again).
- The dynamic nature of the market and the willingness of the TSOs to enable demand side participation.

- **Technical Modality:**
  - The pooled load is measured and pre-qualified at the aggregated level lowering entry barriers and administrative burdens for individual consumers.

Main Market Barriers

- **Rules governing aggregation:**
  - Independent aggregation is not enabled, which means that competition around demand side programs are not possible as the Demand Response program is attached to the electricity price.
    - For example, it would be easy to visualise a larger range of consumers, than green houses, engaging in the wide range of programs available if competitive offers were made.
- **Technical Modality:**
  - The baseline methodology is created through a bi-lateral agreement rather than an open and standardised process.

Poland

Context

Between 2014 and 2015, Poland saw an increase in contracted volume of Demand Response, from approximately 50 to 147 MW. However, Demand Response can only participate in the Emergency Demand Response Programme (EDRP). The balancing market was opened for Demand Response on July 1st, 2014, but due to strict requirements and low payments, there were no consumption bids.

In Poland, coal is the predominant source of energy. Aging coal-fired power plants increase costs of generation, while the demand for electricity is expected to grow continually. As power plants are located mostly in the south of the country, the transmission network faces congestion issues to the North. Thus, DR could add important flexibility resources in areas of the country suffering from transmission and/or generation capacity constraints.

The development of Demand Response in Poland will require legislative changes, as today there is no legal role for the independent aggregator. Another important issue is the question of payments for DR providers. Current regulations provide only for utilisation payments, as there are few calls per year and the payments are low – this constitutes a barrier to the development of Demand Response in Poland.

Status of technical modalities and market opening

The table below gives an overview of the programmes used by the Polish TSO to balance the grid. It can be easily noted that possibilities for Demand Response to participate are limited.

Table16. *Ancillary Services Markets open to aggregated demand*[104]

ENTSO-E's terminology	PSE's terminology	Tot. Capacity Contracted	Load Access & Participation	Aggregated Load Accepted
FCR	Primary Reserve (*Regulacja Pierwotna*)	*n/a*	✗	✗
FRR	Secondary Reserve (*Regulacja Wtórna)*	*n/a*	✗	✗
RR	Automatic Voltage Control Reserve (*Automatyczna Regulacja Napięcia i Mocy Biernej*)	*n/a*	✗	✗
-	Emergency Demand Response Programme (*Redukcja Zapotrzebowania na polecenie OSP*)	176 MW[105]	?	?
-	Operational Capacity Reserve	4 150 MW[106]	✗	✗
-	Cold Intervention Reserves	830 MW (for 2016-17) [152]	✗	✗
-	Balancing Market	*n/a*	?	?

Emergency Demand Response Programme (EDRP). Today, EDSR is the only programme where Demand Response actually participates. The first contract was signed in March 2013 – 30 MW of capacity for summer and 25 MW for winter.

The specifications of the latest tender provide for 24 month contracts (winter or summer seasons). The maximum number of activations during this period is 15, and there can be a maximum of 1 per day and 3 per week. One "testing" activation is guaranteed otherwise activations are not guaranteed. Each reduction can be 2, 3 or 4 hours long. The minimum bid size is 10 MW, which is high, and aggregation of individual units is allowed by the BRP. The consumption units have to be equipped with at least hourly meters. By March 2015, there were 5 tenders, with the latest tender round foreseeing a total volume of 200 MW to be contracted (until the expiration of the first volumes contracted). **Ancillary Services.** Due to the regulatory environment and the lack of transparency, it is not feasible for consumption units to participate in the TSO's system services schemes.

Balancing Market

DR participation was allowed as of July 1st, 2014, but due to the measurement and verification requirements – which closely resemble those required by large generation facilities and are not

[104] *SEDC 2015, Demand Response Map*
[105] from 1 June 2015

[106] CEPI (June 2015):"Demand Side Management Poland", available at: http://www.cepi.org/system/files/public/documents/events/other/8.%20DSM_Poland_CEPI%20Webinar_AM.pdf (retrieved on 10 June 2015).

suited as yet to demand-side resources, **no** DR provider is participating. The requirements need to be adjusted in order to actual provide access. The balancing market also includes "**Operational capacity reserve**". This scheme provides availability payments as an incentive for the generators to be available at peak hours. It is not open to consumers. "**Cold intervention reserve**" is another generation-only scheme, providing capacity (and utilisation) payments to maintain the availability of old power plants, marked for decommissioning.[107]

Wholesale Market

Demand Response cannot be traded even by BRPs on the Polish day ahead and intraday markets. However, the above generation-only capacity schemes, and the coal subsidies have limited price volatility and attractiveness for Demand Response.

Rules governing aggregation

An aggregator must work through the consumers BRP there is no independent aggregation. As the market currently stands, it is unlikely that a retailer will contract with a consumer outside of its own balancing area. In EDRP, aggregation service providers/BRP has a bilateral contract with the TSO. They do not require a contract with the consumer's BRP.

In order to ease the implementation of such agreements and acquire measurement data from DSOs, TSO updated transmission agreements between TSO and appropriate DSO and BRPs.

Measurement and verification take place at an aggregated level.

Within the balancing market, the pool of loads has to prequalify as an aggregate. There is no minimum size for an individual unit within the pool, but there are high requirements in terms of measurement and planning accuracy, as Demand Response providers shall use the same baseline calculation methodology as generators, which is impossible to fulfil and therefore shuts the market to consumers.

Conclusions

Coal is an important part of the Polish economy and the electricity market is designed to support its interests. The electricity price is therefore set according to the price of coal-fired generation, for example prices may not go below the clearing price of coal.

The TSO is motivated by concerns of future capacity issues and has therefore begun to develop consumer-oriented programs. This is done, however, in a context where the true market value of a resource is not transparent and prices are controlled.

There are also strong entry barriers, such as baseline measurements, which are not adjusted to adequately measure consumption reductions. This is an indication of an early stage of market development. If and when the TSO/regulator becomes serious about consumer engagement, they will review these issues.

Main enablers

- There are positive signs from the regulators, e.g. there has been a development of EDRP;

[107] PWC and ING Bank (2014): "5 Myths of the Polish Power Industry 2014", p.22, available at: http://www.pwc.pl/en_PL/pl/publikacje/assets/pwc_ing_5_myths_of_the_polish_power_industry_2014_report.pdf (retrieved on 10 June 2015).

- **Two open programs:** Balancing market is open to Demand Response in theory.

Main barriers

- **Aggregation:** Independent aggregation is illegal.
- **Market structures:**
  - Ancillary services are not accessible to Demand Response and not transparently contracted;
  - There are no availability payments for the participation in EDRP;
- **Technical Modalities:**
  - Complex verification and measurement requirements in the balancing market are considered as prohibitive;
  - Lack of legislation concerning demand-side participation hinders development of the market.

Portugal

Context

Demand Response is not defined in Portugal, though it is not illegal. However, measurement, baseline or payment structures are not in place as yet. Aggregation of consumer load has not yet been defined, though the aggregation of distributed generation is enabled.

The regulator is aware that the structures have yet to be put in place, which would enable Demand Response, (such as how to measure, define and pay for consumption reductions for example) but indicates that as to date no requests for this have come from the market. They intend to handle these issues once they have a push from market participants. In the meantime, they are incorporating storage from pumped hydro plants in the balancing market and point out that this has much the same impact as a demand reduction and is therefore good preparation.

Consumers have had access to a dynamic price of 3-4 price bands per day since 1997, though most consumers have decided to remain on the flat controlled tariff scheme.

Portugal is interconnected to Spain and shares the same wholesale market, the MIBEL, and balancing market structure.

Status of technical modalities and market opening

The following table presents the electricity market product or sub-products and underlines where Demand Response and aggregation could participate, including related market sizes.

Table 17. *Ancillary Services Markets open to aggregated demand*[108]

ENTSO-E's terminology	TSO's terminology	Load Access & Participation	Aggregated Load Accepted
FCR	Primary regulation	X	X
FRR	Secondary regulation	X	X

[108] *SEDC 2015, Demand Response Map*

RR	Tertiary regulation reserve	X	X
RR	Deviation Management	X	X
	Guarantee of Supply Constraints	X	X
	Resolution of technical Constraints (PDBF)	X	X
	Real-Time Constraints	X	X
RR	Power Reserve	X	X
	Secondary Regulation Band	X	X

While the largest consumers have a requirement to shed load during a system security event, Demand Response is not active in Portugal.

A BRP/retailer may include consumers within their portfolio; however, there seems to be little interest from the retailers present in the market. This may partially be due to a large amount of capacity and the capped electricity prices, which slow market development.

Distributed generation can be aggregated and sold but there is no specific enabling regulation for the aggregation of demand. And though it is not expressly forbidden, no infrastructure is in place for such baseline criteria, measurement requirements, prequalification or payment methods. It is therefore not enabled.

There are a few large consumers (such as steel mills), which act as their own retailer/BRP, and participate in the wholesale market.

Rules governing aggregation

Aggregation of load is not forbidden but there is no specific legislation allowing it. There are also none of the surrounding rules for defining roles and responsibilities.

Conclusions

Portugal, while open to the idea of Demand Response in principle, is a closed market, largely due to a lack of regulatory structures defining roles and responsibilities, access rights, measurement, prequalification and all other technical modalities required for creating a clear path for consumer participation.

Main Market Enablers

There are no specific rules against Demand Response or aggregators and the attitude of the regulator is positive toward development.

Main Market Barriers

Portugal is shut to Demand Response and Aggregation due to a lack of regulatory definition and structure.

Spain

Context

Today, Spain relies mostly on hydro and gas for its flexibility needs. As Spain is evolving towards more distributed energy generation, the need for flexibility is expected to increase in the coming years. Despite the fact that there are certain smart grid pilot projects under development in Spain, the development of Explicit Demand Response is yet to start.

Aggregation is not legal in the Spanish electricity system and there is only one scheme allowing Explicit Demand Response: the Interruptible Load programme for large industrial customers. The scheme, which is reserved only for large consumers, is managed by the TSO, Red Eléctrica de España. The programme acts as an emergency action, in case the system is lacking generation and the balance resources are not enough. Though annual tests are conducted, this programme has not been called for many years, raising questions whether it is a genuine interruptible load programme or a form of subsidy to the national industry. There are proposals to open balancing services to Demand Response that could lead to changes in 2016-2018, especially given that a full smart meter roll-out is expected by 2018.

Status of technical modalities and market opening

The following table presents the electricity market product or sub-products and underlines where Demand Response and aggregation could participate, including related market sizes.

Table 18. Balancing market products, including volume and load accessibility in Spain [109]

ENTSO-E's terminology	TSO's terminology		Tot. Capacity Contracted[110]	Load Access & Participation	Aggregated Load Accepted
FCR	Primary Control		n/a	✗	✗
FRR	Secondary Control		2.876 GWh	✗	✗
RR	Tertiary Control		5.142 GWh	✗	✗
RR	Deviation Management		3.252 GWh	✗	✗
	Guarantee of Supply Constraints		4.085 GWh	✗	✗
	Technical Constraints (PDBF)		7.433 GWh	✗	✗
	Real-Time Constraints		2.258 GWh	✗	✗
RR	PowerReserve		3.010 GWh	✗	✗
	Secondary Regulation Band		1.203 GWh	✗	✗
	Interruptible Mainland[111]	5MW blocks	1.190 MW	?1.190 MW	✗
		90MW blocks	810 MW	?810 MW	✗
	Interruptible Islands		≈50 MW	?≈50 MW	✗
	Capacity Market		≈2.500 MW	✗	✗

[109] *SEDC 2015, Demand Response Map*

[110] Red Electrica (2013): "The Spanish Electricity System", available at: http://www.ree.es/en/publications/spanish-electrical-system/spanish-electricity-system-2013 and Red Electrica (2013): "Servicios de ajuste de la operacion del sistema, avance 2013", available at: http://www.ree.es/es/publicaciones/2014/02/servicios-de-ajuste-de-la-operacion-del-sistema-avance-2013.

[111] BOE-A-2014-10399, Spanish Official Gazette (2014): "Resolución de 10 de octubre de 2014", published on 14 october 2014, art.5, (mainland Spain), and Red Electrica (2013), 'The Spanish Electricity System', Ibid. (insular Spain).

Balancing Market and Ancillary Services. Currently, Demand Response has access neither to balancing markets nor to the ancillary services.

***Interruptible Contracts*.** The programme does not allow aggregation and is limited to large industrial consumers, connected to the high voltage grid. It represents an available capacity of 2.000 MW of demand reduction in peak hours. Industrial energy consumers involved in this scheme are construction industries (steel, concrete, glass, etc.), or other material factories (paper, chemistry, etc.) and desalinisation plants (in the Canary Islands). From 2015, a new framework applies for the programme in mainland Spain, while the previous rules still apply in insular Spain[112]. In mainland Spain, 113 consumers were awarded in the tender round for 2015, with 139 connection points[113], while, in insular Spain, 15 consumers were awarded in the tender round for 2014.

The programme is the only 'Demand Response' programme available and it does not allow aggregated demand-side resources to participate. The participants must have in an ICT system, which links them directly to the TSO, and not to the DSO where they may be connected. If they are connected to the DSO's network, the DSO does not participate in it, and it is not even able to forecast it in advance. The retailer's imbalance is directly corrected by the TSO, which takes into account its reduction order. The baseline is set individually; the available capacity is tested around twice a year. The participants have to send the forecast to the TSO monthly for the following two months. In the absence of aggregated Demand Response, there is no regulation concerning single unit requirement or baseline definitions for aggregated loads.

Wholesale market

Only generators with a production unit of at least 50 MW can participate as seller in the wholesale market. Flexibility resources can participate in the spot market, though demand bids with indication of price.

Capacity Market The capacity mechanism allows for the participation of generation units only, providing both availability and utilisation payments[114].

Rules governing aggregation

There is no possibility for aggregated demand-side resources to take part in the Spanish electricity market. There are no standards at the moment defining their relationship with the BRP and the TSO.

Conclusions

While smart meters and dynamic pricing is now starting to be available for residential consumers, the Spanish market has been slow to enable consumer participation in any form of program.

Demand Response and aggregation are not enabled. And little serious effort to change this seems to be underway.

Main Market Enablers

[112] BOE-A-2013-11461 (2013): "Orden IET/2013/2013, 31 October 2013", published on 1 November 2013, modified on 11 march 2014

[113] Red Electrica (2014): "Informacion Subastas TE2015", 2015 tender

[114] BOE-A-2011-18064 (2011): "Orden ITC/3127/2011, 17 November 2011", published on 18 November 2011

There is abundant opportunity – in the form of grid constraints and renewable generation. But there are no enablers. The market is shut.

Main Market Barriers

Demand Response is not enabled in any market, accept for one interruptible program for large consumers which has not been called for many years.

Aggregation is not enabled or allowed in any market.

Bulgaria

Context

The electricity market in Bulgaria is legally liberalised since 2007, however the actual level of unbundling, free market and trading has been limited so far (Ministry of Energy 2015).

The Bulgarian Government has been working to review the liberalisation process and complete a full reform of the energy sector. The Government claims to achieve full liberalisation by the end of 2016 (Sofia News Agency 2016b). The legal framework for Demand Response is not fully admissive (JRC 2015), and Demand Response does not take place. Bulgaria is working on harmonising the energy policy with EU Directives, and is especially lagging behind with the implementation of the Energy Efficiency Directive ((EC) 2015).

Market participants

- **Ministry of Energy** is the main institution responsible for the development of policies related to the energy sector. In 2005, a separate Directorate was designated to deal with energy efficiency and environmental protection.
- Transformed from the State Energy Regulatory Commission (established in 1999), the **Energy and Water Regulatory Commission** (EWRC; DKER) has its legal basis in the Energy Act[115]. In its current setting, the EWRC regulates the natural gas, electricity, district heating and water supply and sewage markets. EWRC is responsible for tariff setting and quality of services of enterprises. EWRC is also responsible for licensing of enterprises and issues permits for construction of transit gas or oil pipelines ((ERRA) 2016).
- The **Bulgarian Energy Holding EAD** (BEH EAD) was established in 2008 to act in activity acquisition, management, evaluation and sale of shares in companies, carrying out business activities in the areas of production, extraction, transmission, transiting, storage, management, distribution, sale and/or purchase of natural gas, coal, electricity, heat and other forms of energy and raw materials. BEH EAD is a shareholding company with 100% state participation.

Other key players in the electricity sector as of 2015 include ((ERRA) 2016; Grozdanov and Dinova Rusev and Partners 2014):

- Generation licensees;
- 1 TSO with wholesale functions;
- 4 regional distribution/supply licensees companies;
- 112 licensed traders of electricity, of which 52 are active.
- The grid is owned and operated by ESO but remains government property and part of BEH EAD company's vertically integrated holding structure.

[115] State Gazette, SG No. 107/9.12.2003, last amendment on 06.03.2015.

Markets open to consumer participation

The Bulgarian electricity markets do not include Demand Response yet, but a progress towards real liberalisation foresees DR development in the near future (JRC 2015).

Transactions in electricity may be concluded at prices regulated by EWRC, or at prices freely negotiated between the parties, or on the stock market, as well as on balancing market (Bulgarian Government 2015).

The electricity market looks as follows (based on ((DG ENER) 2014; Grozdanov and Dinova Rusev and Partners 2014; Sofia News Agency 2016a):

Wholesale market

According to the Energy Act, transactions in electricity at freely negotiated prices may be concluded between electricity producers, electricity traders, the providers of last resort, the operator of the stock market of electricity and the end customers.

Although – similarly to the industrial sector – the consumers connected to the middle-tension grid (mainly small and medium size companies) were officially not eligible for regulated prices any more from July 2012 (Mihaleva, n.d.), but according to estimates, still about 75-90% of the consumers were under regulated prices in 2015 ((EC) 2013).

The Bulgarian market is still small, and in December 2015, the European Commission raised concerns about restrictions on the wholesale market. In particular, the Commission investigated clauses in electricity supply contracts concluded between BEH's production subsidiaries and third parties, such as traders, that impose restrictions on where these third parties could resell the electricity bought from BEH. Furthermore, the suppliers of last instance had to purchase electricity only from the public supplier at regulated price in order to mitigate the inexperience of the new entrants (Mihaleva, n.d.).

Bulgaria has committed to resolve the problem by offering certain volumes of electricity on an independently-operated day-ahead market on a newly-created power exchange in Bulgaria.

The regulated and free markets are divided according to the below:

- Regulated market: includes trading of the base load needed for securing the uninterrupted supplies to the general public. EWRC determines the base load, which is traded under long-term agreements between generators and NEC; furthermore EWRC determines what part of the capacity must be reserved for supply of the base load to NEC.
- Free market: allows that generators conclude bilateral agreements with traders or consumers at freely negotiated prices. Typically, the NPP and other major state-owned generators organise tenders for electricity sold in the free market. All transfers and payments are cleared by the ESO. Some generators also sell at freely negotiated prices under long-term agreements.
- The Bulgarian Independent Energy Exchange (IBEX) started its operations in January 2016, after a month of trial. The market price will be set by the demand and supply on a spot-basis principle. As many as 17 companies participated in the first real session, which is considered as adequate considering the size of the electricity market. Experts report a price that is “too low” in order to be compatible with what is currently being paid under existing bilateral contracts (Sofia News Agency 2016b).

Balancing market

The market for balancing energy is based on annual agreements between ESO and the respective generator to provide balancing energy. The prices are determined for each MWh under complex formulae set by the Electricity Trading Rules, which are adopted by SEWRC. ESO arranges settlement of fees due for balancing energy.

The grid operator has the right to order curtailment of production in cases of overloading and is not liable for compensation for lost profits. Renewable energy production must be granted priority of dispatch (Grozdanov and Dinova Rusev and Partners 2014).

Regulatory status regarding Demand Response and tariffs

The main statutory act of the electricity market is the Energy Act[116], which was revised drastically in 2013 and 2015. The regulatory changes were driven mainly by political pressure to (adapted from Grozdanov and Dinova Rusev and Partners 2014):

- Reduce electricity prices paid by consumers, provoked by the unprecedented social unrest at the beginning of 2013.
- Address the grave financial situation of the National Electricity Company (NEC).
- Complete the liberalisation of the electricity market.
- Transpose the Energy Efficiency Directive.

Under these changes, powers were moved from the Ministry to EWRC, new electricity trading mechanisms were introduced and the basis for the power exchange market were established (Grozdanov and Dinova Rusev and Partners 2014).

However, Demand Response is not dealt with in this policy, although some requirements in Article 14 and Article 15 of the EED are transposed with the Energy Act.

The Energy Act is complemented by the:

- Energy from Renewable Sources Act, which regulates production of electricity from renewable sources.
- The Energy Efficiency Act[117] was adopted in 2008 and last amended in 2013. The law fully transposes Directive 2006/32/EC and Directive 2010/31/EC.

Voluntary agreements exist that can serve as a basis for Demand Response actions. Voluntary agreements may be concluded between the Sustainable Energy Development Agency (SEDA) and the energy sales companies or the owners of industrial systems. There are 4 signed voluntary agreements with the biggest electrical supplying companies on the country's territory and with the only Nuclear Power plant in Bulgaria. They all are obliged persons under the Bulgarian obligation scheme.

According to the NEEAP, the legislation substantiates the introduction of dynamic tariffs as a measure for the final clients to optimise their electricity use by means of:

1. tariffs that take into account the period in which energy is used;

2. tariffs for the critical peak-load periods;

3. pricing in real time;

4. discounts for reducing the use of energy during peak-load periods.

Renewables with impact on DR

The feed-in-tariff (FIT) system and long-term PPAs have been the main incentives for investment in renewable sources, following the start of the transposition of the Third Energy Package. The FIT is fixed for the term of the PPA (12 years for wind and 20 years for PV). However, following hectic and unforeseen policy changes, including the significant reduction in the FIT for wind and solar

[116] State Gazette No. 107/9.12.2003, last amendment on 06.03.2015.
[117] State Gazette No. 98/14.11.2008

production, retroactive measures, such as introduction of access fees, a new 20% fee on production as well as imposition of financial responsibility for imbalances have deteriorated investor interest in new projects and led to the cancellation of a number of RES projects. In addition, in 2015, retroactive fee of 5% was imposed on all electricity producers. Currently, the challenge is to regain investors' confidence. The incentives for small hydro and biomass installations are still intact under the recent changes but investor interest remains low.

Conclusions

Bulgaria has not adopted the proper legislation to support Demand Response yet. There are bilateral contracts between producers and consumers that were traditionally set up before the EU requirements already, however, these involve major producers and consumers and do not elaborate as real Demand Response.

The country is focused on filling in the gap between the EU requirements for liberalisation and its current status, and a lot has been achieved during these last years. It is expected that full liberalisation could be concluded by the end of 2016, which can open up the market also for Demand Response.

Bulgaria faces severe problems due to overcapacity. This is caused partially due to the economic downturn that led to a decrease of both domestic consumption and exports. It is foreseen that demand will not grow significantly in the future. Due to the regulatory strictness and long-term contracts, it seems to be difficult to drive out the least effective power generation facilities, and results in a lock-in problem.

Main markets enablers

According to the NEEAP of Bulgaria the new amendments of the Energy Act will introduce an obligation for the assessment of the energy efficiency potential of gas and electricity infrastructure and for the formulation of concrete measures, investments and implementation schedules to improve their energy efficiency. Such studies could form the basis for the admission of Demand Response and the technical background.

Bulgaria's transmission lines run on great distances, causing large energy losses. In order to accommodate new entrants, i.e. new generation facilities to the grid, Bulgaria has to increase the transmission system capacity. Demand response integration may be a way forward.

Bulgaria has started with a few projects to enable a smart grid. In 2009 CEZ installed more than 18,000 smart meters, which are now purely used for remote metering, but will be available for more efficient use of energy by adapting consumers' supplies to changing daily demand patterns and enabling consumers to feed unused electricity back into the grid. A prerequisite for this is the full liberalisation.

Main market barriers

The legal basis for Demand Response does not exist at the moment. There are changes that open the market for an easier access even by consumers, however, the traditionally regulated market seems to be slow in taking up even new producers. Bulgaria is lagging behind with implementing the Third Energy Package.

Policy uncertainty and retroactive changes in the Renewables market, extrapolate to a general investment feeling. Furthermore, the reduced development in renewables, and the limited grid capacity have been considered as a major obstacle for the inclusion of Demand Response.

Technically, the grid and the consumers (smart meters) are underdeveloped. Although there have been a few independent (mostly supplier financed) smart meter installations, the possibility to extensive Demand Response is limited technically.

Finally, prices are mostly regulated, and only a small portion of the market is based on free market. The recently initiated power exchange will be a crucial step forward.

Croatia

Electricity from Crodux can be bought by all segments and categories of electricity consumers in the Croatian market, and the partnership with Alpiq will be gradually expanded in the region as well.

Context

The Croatian electricity market is characterised by low liquidity, even though the Third Energy Package has been legally transposed in 2012 through the Energy Law[118]. Competition is very low and it is necessary to increase efforts to improve the situation for new market entrants (DG ENER 2014). The Croatian energy sector has been concentrated with one single state owned energy holding company, HEP. The operations of production, transmission, distribution have been unbundled, however supply and trade remain to be separated (Peltoniemi 2015).

Croatia is an energy importer, with the majority of imports from Bosnia-Herzegovina. Also, import-relations exist with Hungary, Slovenia and Serbia and Kosovo network area. However, Croatia also exports considerable large amounts of power to Slovenia.

Market participants

The key market actors include the following companies (((ERRA) 2016; Peltoniemi 2015):

- Croatian Energy Regulatory Agency (HERA) was established in 2004 as an independent body. Funds for financing the work of HERA are secured from income from its own activities (collection of one-off fees and compensations)
- The Croatian Transmission System Operator (HOPS) was established in 2013.
- Electricity distribution and supply activities are carried out by Croatian distribution system operator HEP-ODS.
- HEP-ODS also provides electricity supply as public service, resulting in a lack of full unbundling.
- The Croatian energy market operator HROTE was established in 2005 by HEP-Group, with key responsibilities including organization of electricity and gas markets as public service. It operates under the supervision of HERA.

Markets open to consumer participation

The level of legal market opening is 100% since August 2008, according to which all customers are eligible to participate ((ERRA) 2016). Households can stay under regulated tariffs, and they mostly do. In effect the real market opening is around 50%.

Demand response does not take place and it is not mentioned by the law. The key reason is the lack of competition, which makes Demand Response non-economic.

Balancing Market

Apparently, a study in 2012 (Energy Community Regulatory Board 2012) found that “balancing” is understood differently in countries of South-East Europe. In Croatian Law, “balancing” is used to mean “energy purchased or sold by the TSO to balance the whole system” and also to refer to “imbalances of individual market participants”.

The reserve capacity is fully based on incumbent generator (Energy Community Regulatory Board 2012), and Demand Response does not participate. The provision of balancing energy for primary,

[118] Official Gazette 120/12

secondary and tertiary reserves is mandatory, with a time-horizon of one year. The payment for activation of reserve energy is based on regulated prices in Croatia, which is included in the transmission tariff. It is the responsibility of the Regulatory Authority to prescribe methodology for provision of balancing services. The TSO is also obliged to act as Balance Responsible Party for renewable energy.

Wholesale Market

The wholesale market functions on a bilateral basis and the prices are freely negotiable. However, the competition in the market is very limited (SeeNews 2015). The generation sector is dominated (95% ownership) by HEP - Group and TE Plomin d.o.o which is co-owned by RWE and HEP. The Cross-border transmission and allocation of interconnection capacity is progressing.

The power exchange market, CROPEX, was founded in 2014, in order to ensure an open electricity market and Day-ahead electricity auctions. It will be launched on 10 February 2016 (SeeNews 2016). CROPEX plans to introduce an intraday local market later in 2016 in a bid to join the European Cross Border Intraday (XBID) project, and intends to be fully integrated with the XBID in 2017.

Demand response has not taken place.

Retail market

According to the law, all customers are eligible and free to choose their supplier. The prices have been going up constantly for households, nevertheless remain low compared to other EU MS and regulated. However, the market has seen a few new entrants in the last years.

Status of regulation concerning aggregators

The Energy Act is the key regulatory framework and has transposed the Third Energy Package in 2012[119].

Further relevant regulation include:

- Act on the Regulation of Energy Activities ("Official Gazette", No. 120/12)
- Act on the Electricity Market ("Official Gazette", No. 22/13)
- Act on the Gas Market ("Official Gazette", No. 28/13,14/14)
- Act on the Oil and Oil Derivatives Market ("Official Gazette", No. 19/14)
- Act on Production, Distribution and Supply of Thermal Energy ("Official Gazette", No. 80/13,14/14,102/14)
- Act on Energy Efficiency ("Official Gazette", No. 127/14

Conclusions

Demand response is not properly regulated in Croatia, and does not take place. The electricity market is concentrated, and the liberalisation process is lagging behind, although recent years have seen a few steps towards a market available also for DR.

Main markets enablers

The market is moving ahead slowly towards full liberalisation. Consumers are open for switching suppliers in spite of the regulated prices (Energy Community Regulatory Board 2012).

Furthermore, the power exchange market is about to be launched, and alternative prices will be available. A move away from bilateral contracts is foreseen.

Main market barriers

Demand response in not yet legally supported, and even the livberalisation process has been slow. Attention is now given to an increased unbundling and removal of regulated prices.

The electricity system is fully based on the supply.

[119] Official Gazette No. 120/12,14/14

Czech Republic

Context

The Demand Response system running in the Czech Republic currently was installed decades ago, and it is based on ripple control (Ministry of Industry and Trade 2014). The ripple control system is similar to radio teleswitch, in that it can be controlled centrally, only that it uses the power line communication (McKenna 2013). Ripple control is linked to the electric heating appliances, providing the technicalities for a time-of-use pricing. Though the technology and the price system are rather outdated only small changes have been implemented towards modern Demand Response integration, and Demand Response cannot move towards a broader application, unless a major step is taken (JRC 2015).

All customers are given a right to choose their electricity supplier and product; however, they cannot choose their regional DSO. The access to both transmission and distribution grid is regulated. The prices are regulated by ERU and set using revenue cap regulation (Stepan Krska 2014).

Market participants

The **Energy Department of the Ministry of Industry and Trade** is in charge of the country's energy policy. Following the closure of the Czech Energy Agency, the promotion of energy efficiency and renewable energy was also transferred to the Ministry.

The **Energy Regulatory Office** (ERO) was set up on 1 January 2001 under Act No. 458/2000 (the Energy Act), as an administrative authority responsible for regulation in the energy sector. ERO is responsible for price controls, providing support for the use of renewable and secondary energy sources and combined heat and power generation, protection of customers´ and consumers' interests, protection of licence holders' vested interests, inquiries into conditions for competition, support the competition in the energy industries, and supervision over markets in the energy industries.

OTE, a.s. is the Czech electricity and gas market operator. OTE was established in 2001. OTE organizes trading in the day-ahead, the intra-day and block electricity markets. OTE offers continuous data processing and exchange required for the accounting and settlement of imbalance between the contractual and actual volumes of electricity and gas supplied and received are among services offered by the OTE to players in the Czech electricity and gas markets, as well as administrative procedures associated with a switch of supplier.

CEPS, a.s. is the TSO, which balances the supply of electricity with demand on a minute-by-minute basis; operates, maintains and further develops the Czech transmission system; ensures electricity transmission between generators and distributors; is involved in the allocation of available transmission capacity on interconnectors by auction and cooperates with other transmission system operators throughout Europe and contributes to the development of the wider electricity market.

Power Exchange Central Europe (PXE) was established in July 2007, and as of 2016, it offers trading in Czech, Slovak, Hungarian, Polish and Romanian electricity. PXE also offers end consumers the opportunity to find the best electricity supplier by means of electronic auctions since November 2014.

There are three licensed **regional DSOs**, and the energy distribution market is a typical example of natural monopoly (Stepan Krska 2014). The customers cannot change the regional distributor. Power plants with lower wattage may be connected directly into the distribution network. The fees for electricity distribution also comprise the contribution for RES.

There are more than 300 licensed retailers.

Markets open to consumer participation

Legally, the wholesale and balancing markets are available for Demand Response, but in practice this is limited to the ripple control mechanism (see below) and aggregation is not happening. Traders have no platform available to carry out aggregation (JRC 2015). Generation is traditionally considered as the means to control the electricity balance, and consumers have not entered the market (JRC 2015). The Third Energy Package has been transposed fully, and all consumers are eligible to choose their suppliers (JRC 2015).

Wholesale Market

The wholesale market is populated primarily by large producers and consumers (JRC 2015). The concentration is particularly high, with ca. 80% of the generation market share in the hands of one company (DG ENER 2014)

Electricity trading can take place in the form of bilateral negotiated agreements (OTC) or on the spot market (day-ahead and intra-day market) operated by OTE as the market operator or on the Power Exchange Central Europe, and on the Czech-Moravian Commodity Exchange, Kladno (Nedelka, Lindinger, and Hocková 2012). It is estimated that most of the trading takes place on the power exchange (JRC 2015).

The Czech day-ahead market was integrated with the Slovak day-ahead market since 2009. Czech electricity traders can place bids for purchase and/or sale of electricity for the whole territory of Slovakia and the Czech Republic. OTE also operates the intra-day market. Trading on the intra-day market is conducted via a notice published on the internet that sets out all offers for the purchase and sale of electricity.

Balancing Market

When the intra-day market closes, the market operator moves the bids onto the balancing market, where electricity can be traded to/from the TSO, i.e. ČEPS, a.s. (Nedelka, Lindinger, and Hocková 2012).

Ripple control is still the main mechanism for managing the distribution grid constrains, however it was widely used to cover the balancing market until ca. 2005 (JRC 2015). After 2005 the ownership and control of the system passed to the distribution network companies (JRC 2015).

The costs of ripple control are incorporated into the price for the distribution of electricity. The main reason for using ripple control is to spread out consumption evenly, i.e. to optimise the operation of the distribution system. Ripple control is also used to handle emergencies in the grid. In the face of emergencies and other high-alert situations, ripple control is used to prevent and eliminate such situations and to clear up any consequences thereof. (Ministry of Industry and Trade 2014)

Status of regulation concerning Demand Response

The central legislation of the electricity market is the Energy Act (Energetický zákon), which sets out the conditions for business activities, regulation and public administration in the energy sector. More detailed provisions on trading are comprised in the Electricity Market Rules Decree.

The distribution system is incentivized to reduce overall losses in distribution networks, and distribution companies receive a financial compensation if they can increase the efficiency of electricity distribution. If a DSO achieves a reduction in the share of losses in distribution, the difference between the permitted costs of losses and the actual costs of losses will be realised as additional profit (Ministry of Industry and Trade 2014).

Tariffs

Time-of-use tariffs and real time pricing are used in the Czech Republic (JRC 2015)

Ripple control is associated with two tariffs: the first is an 8-hour off-peak time-of-use pricing tariff, while the second is a 20-hour off-peak time-of-use pricing tariff (McKenna 2013; Ministry of Industry and Trade 2014). The share and timing of these slots have been changing drastically, making them more and more user-friendly (JRC 2015) (adapted from Ministry of Industry and Trade (2014)):

- *Eight-hour accumulation* –designed for electrical appliances with storage (e.g. a boiler) used to heat water or a building. With this rate, the installed electrical equipment and its load must have a value corresponding to at least 55% of the value of the main circuit breaker before the electricity meter. These appliances heat up water during the low tariff period. The low tariff is controlled during the day based on developments in electricity consumption in the Czech Republic. The low tariff switchover time is determined by the distributor. The low tariff may be broken down into several intervals throughout the day. The aggregate of these times must always be at least eight guaranteed hours. The minimum uninterrupted interval for the low tariff is one hour. Modes: low tariff lasting at least eight hours a day, high tariff lasting a maximum of 16 hours a day.
- *Sixteen-hour accumulation* –designed for hybrid electrical appliances (a combination of storage and direct appliances) used to heat water or a building. The sum of the output of all devices must correspond to at least 50% of the value of the main circuit breaker before the electricity meter. Modes: low tariff lasting at least 16 hours a day, high tariff lasting a maximum of 8 hours a day.
- *Direct heating* – designed for electric direct appliances used for spatial heating. The sum of the consumption of all devices must correspond to at least 40% of the value of the main circuit breaker before the electricity meter. Modes: low tariff lasting at least 20 hours a day, high tariff lasting a maximum of 4 hours a day.
- *Heat pumps* – designed for spatial heating by means of a heat pump. Modes: low tariff lasting at least 22 hours a day, high tariff lasting a maximum of 2 hours a day.
- *Weekend* – designed for weekend stays, where the cheap electricity tariff (the lower tariff) is set year-round from midday on Friday until 10 p.m. on Sunday.
- Since 2013, it has been accompanied by a special tariff designed for the recharging of electric vehicles, which is contingent on the ownership or right of use of an electric vehicle. The low tariff mode lasts for eight hours a day during the night.

Distribution and other network tariffs are cost reflective of cost-savings and they do not prevent the network operators or energy retailers making available system services for Demand Response (JRC 2015).

Renewables

The Renewables Support Act was introduced in 2005, and was a very significant support for the industry, inspired by the German energy transition. The subsidies kicked off rapid growth of wind, biomass and even solar energy, especially around 2010, when the investment prices declined. This caused legislative turbulence due to the socially debated high rates of support, which was overcome by retroactive changes, such as the solar tax, which destabilized the business environment. After 2010, new photovoltaic panels could only be installed on buildings, and in 2014, support was cut off without substitution for these installations altogether. Positive changes started again in 2005, including an amendment to the Energy Act, based on which small-scale plants with an installed capacity of up to 10 kW will not be required to acquire a license.

The Green Bonus scheme defines a premium for electricity produced from RES to be paid by the Czech electricity and gas market operator (OTE) and an obligation to purchase by the DSO. In support in the form of green bonuses , the producer has to find the customer electricity itself as it can negotiate the price

Smart grid and smart meters

According to the third NEEAP (Ministry of Industry and Trade 2014), a Smart Grid Action Plan has been prepared in order to explore opportunities to facilitate a smart grid and Demand Response.
Beforehand, two pilot projects were carried out by the two key electricity companies around 2007-2009 (JRC 2015). The primarily purpose of the pilots was to assess the feasibility and reliability of various AMI/AMM technologies. Both projects met a number of miscellaneous technical problems and bottlenecks. A larger scale test was done in 2010 with the inclusion of about 40 thousand measuring points (ca. 1 % of all the metering points serviced by the given company), which was seen to lead into a mass-scale roll-out of smart metering technology in one region by 2015, however according to the cost-benefit analysis carried out as a requirement of the Third Energy Package, the Czech Republic is one of the few countries, where a full roll-out would not be beneficial (Zdanik 2015). The reason for the result may lie with the ripple control system, which is incompatible with the modern smart metering devices, and therefore the costs would be higher and benefits lower than in other countries. In 2016, a new study is expected, taking into consideration new developments and new legal and political circumstances.
Therefore, at the moment there is no official plan for mass-scale implementation of smart metering in the Czech Republic yet.

Conclusions

The Czech electricity market is liberalised, and there are a large number of players. Nevertheless, the generation is still very concentrated. While, some kind of Demand Response is running and successful in the Czech Republic, it cannot supply or the requirements established by modern systems.

Main markets enablers

The ripple control system has acted as a Demand Response mechanism since the 1960s. It is based on the dual tariff offers, and is able to compensate distribution constraints.
At the moment, the prices motivate energy savings. The fix fees are low, compared to the consumption-related costs. However, the Government is considering to increased the fee for distribution access in 2016, which could actually demotivate energy savings and Demand Response interest (JRC 2015)

Main market barriers

While ripple control worked well for balancing until about 2005, and is still operational and supported, it is outdated. However, it is very difficult to step away from this mechanism, which is built in and used by about 40% of the customers. While this is a suboptimal solution which is not compatible with smart meters and smart grids, the cost-benefit ratio to implement a modern smart system is too negative.

Probably in 2016, a new CBA will be carried out, which may value the advantages of developing a smart grid system, and thus provide a wider-scale opportunity for Demand Response.

Hungary

Context

The energy system of Hungary is traditionally based on ensuring an overcapacity in supply, and therefore Demand Response is an alien solution both at the policy-making level and at the customers' perception. There have been no capacity issues for decades, neither are they foreseen even on a long term, and as a result, there is no local driver for the roll-out of DR and/or smart solutions and/or renewable source technologies. These "alternative" solutions are largely driven by European obligations and market forces, and their regulation is rather low scale or non-existent.

Therefore, energy policy has been directed more by social than environmental targets (and resulted in utility cost reduction programmes), import agreements and the extension of traditional power production.

Liberalisation is not fully successful, switching is rare (Alfoldi et al. 2014).

Market players

Based on Alfoldi et al. (2014):

- 12 companies that operate power plants with a capacity of 50 MW or above;
- 233 companies that operate power plants with a capacity of 0.5-50 MW, of which 169 really active in 2014;
- The Hungarian Energy and Public Utility Regulatory Authority ("Magyar Energetikai és Közmű-szabályozási Hivatal") – HEA, called until 2013 the Hungarian Energy Office, HEO – is an independent body of the administration.
- MAVIR is owned by the state-owned company Magyar Villamos Művek Zrt. (Hungarian Electricity Ltd., MVM), a major player both in generation and on the wholesale markets. Mavir was certified by the Regulator in March 2012 as an independent transmission system operator (ITO);
- Operators of private lines: 4 companies;
- 8 Virtual Power Plants;
- One large industrial plant, which participates in DR.

Hungary has a robust infrastructure both in electricity and natural gas sectors, which have not been developed through recent years. As a consequence of residential utility rate cuts in 2013 and extraordinary taxation on energy infrastructure, companies are dissuaded from making further investments, except for a few EU funded projects.(DG ENER 2014)

Directive 2009/28/EC requires from Hungary a 13% renewables share within the total gross energy consumption by 2020, and this target was further raised in Hungary's National Reform Programme and the NREAP to 14.65% (DG ENER 2014). In general, the country is on track to reach its target, but RES share in electricity was dropping between 2011-2014 (going below 2009 levels), and the market changes dissuade further development, while licencing is almost not possible.

Markets open to consumer participation

Legally, all markets are open for large and aggregated consumers (JRC 2016), but its scale is limited and is not linked to the ideal from the EED. Participation is based on consumption balancing rather than capacity balancing (JRC 2015).

Wholesale market

The wholesale market is based on long-term (1-2 years) bilateral contracts between the retailers and the large consumers, and a profile is submitted to MAVIR, which is confirmed 1 month and 2 days beforehand. Direct contract with the operators is possible, but very rare. Penalty is extracted in case of non-compliance. Therefore, there is no market opportunity to react to prices. There is an over-the-counter (OTC) market and participation at the HUPX is also possible. The Hungarian energy exchange (HUPX) works well, and about 30% of the supply is sold here. Intra-day tariffs were introduced from 2016. Large consumers, retailers and aggregated consumers are allowed to participate in this system (JRC 2015), however entrance is difficult and very expensive and there are liquidity problems. The combination of bilateral contracts and participation at the exchange is common.

Balancing market

MAVIR, the TSO is responsible for the security of supply and balancing the electricity system. Balancing is based almost fully on the overcapacity of power plants, and is hampered by the low number of participants. Offerings are auctioned, and the price is going down.

While DR is legally allowed, administrative hurdles are so strong, and MAVIR is so reluctant to issue a licence that so far only one company can offer DR services, namely BorsodChem. This is a chemical factory that can react very rapidly to changing demand, and has a local CHP power production in addition that can be used by the factory to make up for the lower electricity supply.

Smaller consumers (residential and public) are also allowed to participate in DR, but in the lack of motivation and market rules, they are not represented on the market. On the other hand, residential and tertiary consumers have been offered time-of-use-tariff system for decades, using the ripple control technology. Similarly large consumers have also a choice to select the two-tariff price system (also called switching tariff) for the last 30 years, and in this system the network operator is allowed to switch on and off the consumers electricity use (JRC 2015).

Dynamic pricing does not exist in Hungary, due to the lack of technology, which is not yet installed, and smart meter projects are at the piloting level at best. Smart grids are used by aggregators, but not for pricing. The pilots do not imply a roll-out in the near future.

While Demand Response is not recognised as a normative practice and/or as a source of negawatts, consumption restriction is allowed as a crisis solution through a ministerial decree to be issued jointly with the other ministers concerned in the regulation (IEA 2014).

Since 1979, Hungary has had rules and legislation giving the minister responsible for energy wide-raging authority to impose demand restraint measures. If necessary, a parliamentary decision can also be prepared. Hungary distinguishes three levels of demand restraint: light-handed, medium-handed and heavy-handed measures (adapted from: IEA 2014).

The light-handed measures can be executed within a few days and would result in a 2% to 4% reduction in consumption. They include:

- publicity to encourage fuel savings
- avoiding the use of cars for short distances
- reducing the temperature of public buildings
- encouraging a reduction of the temperature in dwellings.

The medium-handed measures would take one to two weeks to implement and would result in a 4% to 8% reduction in consumption (including the aforementioned light-handed measures). They include: „

- introducing driving and speed restrictions
- prohibiting driving for one day a week or at weekends
- restricting the use of passenger cars based on registration numbers
- reducing the quantity of fuel that can be purchased at filling stations
- restricting the deliveries of oil products.

Heavy-handed measures include:

- the introduction of quotas on fuel oils for large customers (amounts to be determined by a crisis committee)
- retail quotas and restriction of fuel oil deliveries for small customers
- a restriction on the use of motor fuels by the chemical industry
- the introduction of rationing tickets for motor fuels in the private sector; the introduction of quotas on motor fuels in the public sector
- the allocation of quotas on motor fuels for the trading and services sector.

The impact of the heavy-handed measures has not been quantified and could take two to three months to have an effect.

Status of aggregators

Aggregation of demand is not known. There are 8 Virtual Power Plants (VPP) operating in Hungary, with the first started in 2011. They are mostly concerned with the aggregation of small (1-3 MW) CHP plants into larger pools, mounting up to 1000 MW capacity. The number of participating gasmotors is around 600. The VPPs set up and operate

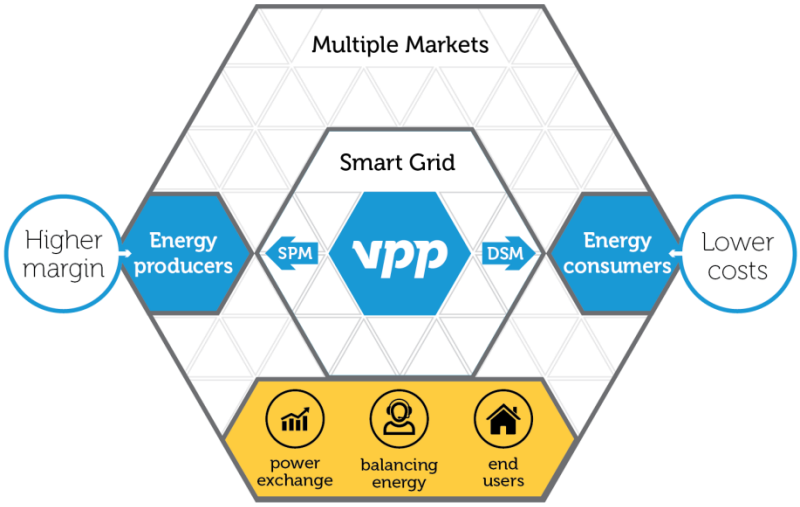


Figure 1. The business model of VPP, the first aggregator in the Hungarian Demand Response market.

Conclusions

Main markets enablers

The main driver of Demand Response in Hungary is the natural development of markets. Demand response is based on the surplus production of electricity by CHP plants. The small producers are collected by aggregators and large consumers may act on their own.
The HUPX is also a successful element of the DR market.
Large energy suppliers have ancillary services and even public awareness raising programmes, but the government is lagging behind with education, awareness raising and supporting energy savings in general and especially in Demand Response.

Main barriers

There are a number of reasons why Demand Response has not increased from the minimum level that has been present for decades. These barriers can be categorised as macroeconomic or structural and regulatory or strategic. The key result is the demolition of motivation on the side of consumers and the lack of opportunities on the side of suppliers.
The key structural reason for a lack of interest in DR is the **low cost of import energy prices** (JRC 2015). As long as these are available based on long-term agreements with importers (almost exclusively Russia), the relative cost of preparing the network and introducing smart technologies (smart meters and smart grids) remains too high.
Furthermore, **wholesale prices** have decreased across Europe, and this was also reflected in Hungary, while **overall consumption** (final and primary energy) **actually decreased** steadily from 2008 mainly due to weak economic development (Ministry of National Development 2015).
Furthermore, the Hungarian government introduced **obligatory price reduction** on utility prices for small consumers in 2013 and 2014, which translated into a ca. 25% price decrease of retail prices of

gas and electricity compared to 2012 (DG ENER 2014). With such a drop of costs, energy efficiency and Demand Response have lowered values.
On the public authorities' side, there is a problem with **split incentives and with fixed fees**. These consumers have energy price (and consumption level) agreements for at least a year, and peak consumption is not defined in these agreements, therefore the consumers spread their consumption on their convenience.
The macroeconomic barriers are linked to the regulatory barriers. Currently, there enough power plants that can supply the domestic demand and also produce for exports. The governmental approach is to **expand the supply side** (in particular the Paks power plant), which has a message against energy and capacity savings. Furthermore, it is not beneficial to reduce demand, when supply is being increased.

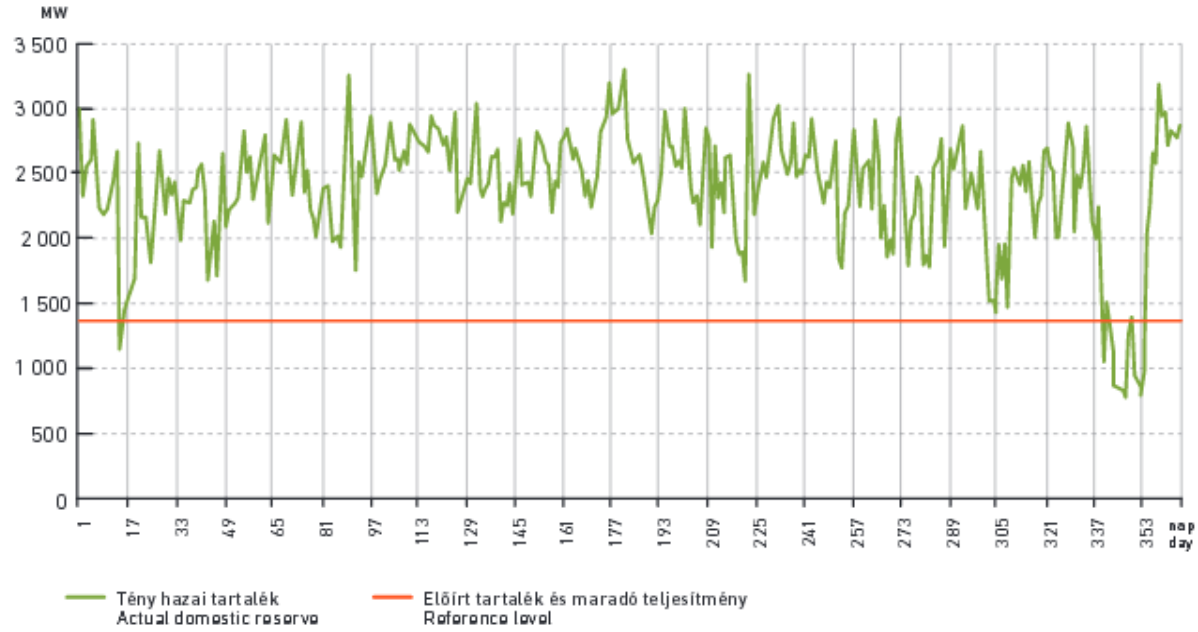


Figure 2. Gross reserves at daily peak (2013)

The **connection** of renewable is technically and administratively **difficult**. The feed-in tariff does not encourage netmetering, even though the legislation provides priority to local producers. Biomass has a special support system, and has been growing more rapidly. Wind power and solar power are mainly supported from grants, which have been closed for years.
The energy sector is subject to an energy tax, a differentiated profit tax and a crisis tax. The crisis tax was set on (generation and supply) energy companies' taxable revenue, and later the government imposed a new tax on infrastructure, set by the length of transmission and distribution lines and pipelines.
Due to the **special taxes** and the price caps, several **supply companies have left (part of) the market**. The Hungarian public companies are taking over these markets and produces a centralisation process, which seems to be risky and costly.

Romania

Context

After the full liberalisation in 2007, on legal terms, there is a decentralized electricity system in Romania in which the generation, transmission, distribution and supply activities are separated and provided to final consumer by suppliers. The market is continuously expanding since then.

Electricity trading on the Romanian market is carried out through two market segments:

- Regulated market,
- Competitive market.

Price regulation for non-domestic sectors was phased out starting from January 2014.

Demand response is legally allowed on the wholesale and the balancing markets, nevertheless the activity is very limited.

Market participants

The Romanian Energy Regulatory Authority (ANRE): From 2012, after the approval of the Electricity and Gas Law no.123/2012, ANRE is an autonomous administrative authority, under Parliamentary control, entirely self-financed and independent. Key responsibilities (Vasiliu and Ene 2015) of ANRE are regulating the electricity and gas sectors, setting up prices and tariffs for the captive consumers and for natural monopoly segments of the markets, monitoring the electricity and gas markets and compliance with the regulations, authorisations and licensing ((ERRA), n.d.).

Ministry of Energy, SMEs (Small and Medium Size Enterprises) and Business Environment: The Ministry is responsible to apply the government programme and strategy in the energy sector, monitor the energy sector and the compliance with international treaties in the energy sector. (Vasiliu and Ene 2015)

Transelectrica is the TSO: it was founded by the Government Ordinance No. 627/July, 31, 2000 further to unbundling the former Romanian Electricity Authority (CONEL). The company is responsible for electricity transmission, and therefore it is completely separated from the generation, distribution and supply activities. From the technical viewpoint, the electric power system remained unitary, managed by a unique operator.

Electricity Market Operator (Operatorul Pietei de Energie Electrica si Gaze Naturale “OPCOM” S.A., OPCOM[120]): OPCOM is the electricity market administrator. OPCOM provides the framework for the deployment of commercial trade on the wholesale electricity market and performs administration activities of the centralized markets in the natural gas sector.

Furthermore there are 667 generators, license holders, 8 DOSs with more than 100,000 customers, and 195 suppliers, license holders ((ERRA), n.d.)

Markets open to consumer participation

The electricity market is divided into a wholesale market and a retail market (Vasiliu and Ene 2015). Demand response and aggregation are allowed on both the wholesale and the balancing markets.

Balancing Market

Demand response is allowed in the balancing market, and aggregation is legally frameworked, however, no incentives are provided.

The balancing market is handled by the TSO, Transelectrica, which also acts as the metering operator. Interested parties (producers and consumers) have to either register as a Balancing Responsible Party (BRP) or join an existing BRP which undertakes the balancing obligation. The TSO registers participants to the balancing market, collects and validates offers and determines the

[120] http://www.opcom.ro/compania/compania.php?lang=en&language.x=12&language.y=2

volumes needed for settling the transactions. Although this is not explicitly defined, joining a BRP is the basis for aggregation, even though pooling is not known yet (JRC 2015).

Settlement itself is currently ensured by the market operator, OPCOM acting as settlement administrator. OPCOM provides settlement calculations for transactions concluded on the day-ahead market and the balancing market. Settlement services are available for a regulated tariff.

19. Table Overview of the Romanian balancing market. Source: (Energy Community Regulatory Board 2012)

Requested Balancing Energy [MWh]	2007	2008	2009	2010
	3.492.000	3.546.000	3.206.000	2.965.000
Responsible for preparing legal framework	Regulatory Authority (ANRE)			
Responsible for Balancing	TSO (Transelectrica SA)			
Responsible for Balancing Market Operation	TSO (Transelectrica SA) and Market Operator OPCOM SA for BM settlement			
Responsible for Market Monitoring	TSO (Transelectrica SA) & Regulatory Authority (ANRE)			

The ancillary services are obligatory and are based solely on producers, demand is not present (ANRE 2015).

Wholesale Market

The sale of electricity between generators and suppliers can be performed only on the centralised platforms operated by Opcom. Transactions can be concluded on several alternatives, such as the Centralised Market for Electricity Bilateral Contracts (CMBC), the Day Ahead Market (PZU), the Intra Day Market (ID), Over-the-counter (OTC) market, and the Electricity Market for large consumers (PMC) (Cojocaru and Velicu 2014).

By the enactment of Law No. 122/2015, as an exception from the provisions of Electricity and Natural Gas Law, producers of E-RES operating power plants with a capacity not exceeding 1 MW or 2 MW in case of high efficiency cogeneration have the opportunity to sell their electricity directly to suppliers of electricity to end-consumers by concluding direct negotiated PPAs.

Regulatory status regarding Demand Response and tariffs

Law no. 121/2014 on energy efficiency is the central legal piece for Demand Response. In effect, this law transposes all the critical provisions of the EED, but these are not yet translated to secondary legislation and/or practice.

Key provisions are (JRC 2015):

- Art.15, alin.(3): “Electricity transmission and distribution network regulation and network tariffs approved by ANRE fulfill the criteria in Annex VIII, taking into account guidelines and codes developed pursuant to Regulation (EC) No 714/2009”;

- Annex VIII: “Network tariffs shall be cost-reflective of cost-savings in networks achieved from demand-side and demand- response measures and distributed generation, including savings from lowering the cost of delivery or of network investment and a more optimal operation of the network”

- Annex VIII: “Network regulation and tariffs shall not prevent network operators or energy retailers making available system services for Demand Response measures, demand management and distributed generation on organised electricity markets” Note: network tariffs are constant and do not incentivize the shift between peak and off-peak.

- Network tariffs do not hinder “energy savings from Demand Response of distributed consumers by energy aggregators”.

- Network tariffs do not hinder “demand reduction from energy efficiency measures undertaken by energy service providers, including energy service companies”.

- Art.15, alin.(6): “ANRE verifies the transmission and distribution network tariffs and if necessary, ensures the removal of those incentives that are detrimental to the overall efficiency (including energy efficiency) of the generation, transmission, distribution and supply of electricity and natural gas or those that might hamper participation of Demand Response, in balancing markets and ancillary services procurement of the final customers themselves or by energy aggregators”.

- Art.15, alin.(7): “ANRE includes in the transmission and distribution network tariffs incentivised rules for the transmission and distribution network operators for electricity and gas in order to improve efficiency in infrastructure design and operation and the network tariffs allow suppliers for electricity and natural gas to improve consumer participation in system efficiency, including Demand Response, accordingly to the Law 123/2012 for electricity and natural gas, with the following modifications and supplements”.

- Art.15, alin.(17): in order to promote access of the final customers to the system services markets, transmission system operator and distribution system operators have the obligation to elaborate technical modalities for participation in these markets based on Demand Response, that are submitted for approval by ANRE. In order to set the mentioned technical rules the transmission system operator and distribution system operators cooperate with the final customers and the energy aggregators

The energy efficiency law builds on the Electricity and Natural Gas Law No. 123/2012, which gives the principles of the electricity market, and it was subsequently amended and completed and detailed in secondary legislation. Electricity-related activities are strictly regulated under the Electricity and Gas Law and are usually subject to a specific authorisation or licensing by the Romanian Energy Regulatory Authority (ANRE).

Renewables with impact on DR

In promotion of electricity from RES, there is a regulatory framework in place including mandatory quotas and a green certificate market (AEA 2014), however these have been undergoing significant changes between 2011 and 2015, leading to reduced support for green certificates.

This legislative instability and the lack of predictability proved to be the main obstacles in the medium and long term for RES. Furthermore, in new regulated obligations for producers there is an obstacle, such as, to pay a specific tariff for the reinforcement of the transmission or the distribution grid (a tariff that amounts around EUR 100,000/MW), or to provide for financial guarantees for the connection of the project (so that in case the project will not be built, for whatever reason, the guarantee will be lost).

Smart grid and smart meters

A number of pilot projects had been implemented to explore the validity of smart meters and smart meter systems in Romania. These include:

- Installation of advanced metering management systems to approximately 1300 households and small economic operators (low voltage consumers); the meters communicated via electrical lines combined with fibre optics and GPRS;

- Starting a remote reading system for about 8000 households and small economic operators, using GPRS as communication infrastructure;
- Installation of advanced metering management systems to nearly 13 000 households and small economic operators; communication was via PLC (from low voltage to medium voltage), and consumption was measured every 60 minutes;
- An automatic reading system, installed to about 35 000 economic operators, using GPRS communication.

According to the 3rd NEEAP of Romania (Romanian Government 2015), a study was carried out in 2012 about 'Intelligent Metering in Romania', and it found that implementing intelligent metering in the electricity sector has the potential to be a profitable investment due to the benefits from reducing grid losses and operating costs for utilities.

Therefore, ANRE Order No 91/2013 on the implementation of intelligent metering systems for electricity was adopted. At the moment, further pilots are running to test the optimal characteristics for each DSO, in regards to cost-effectiveness (Romanian Government 2015). The final timetable, with implementation details (e.g. funding) was to be prepared by the end of 2015, but to our knowledge, this is not yet available at the time of writing.

Conclusions

As of 2016, Demand Response is not taking place in the Romanian electricity market. The legal framework is well-established, the Government has transposed all the relevant provisions of the EED, and the 3rd NEEAP highlights the importance of Demand Response.

However, due to a number of key barriers, DR has not taken off the ground, and for the moment there are no plans or actions that indicate a change.

Main markets enablers

The legal background is fully in place, both the Third Energy Package and the EED are transposed. Based on the legal documents, tariffs do not involve barriers to the cost effectiveness and in general for the participation of DR. Demand response is allowed in the wholesale and balancing markets, as well as aggregators, but has not taken up.

Renewable facilities have been sprouting, due to a generous support system, including green certificates and later the introduction of FiT.

Main market barriers

Although the legal framework is established, in reality, Demand Response is not taking place. There are a number of technical, structural and historical barriers.

First of all, the electricity system is traditionally supply driven, and additional power supply is being constructed to cover the full demand, instead of involving Demand Response as an alternative solution. Some of the construction is state-aided, and therefore the relative cost-effectiveness of Demand Response is reduced.

Secondly, the legal framework is a word-by-word translation of the EU directive, and it is unclear how this will influence the practical side. It has been noted, that secondary legislation would be necessary as a next step. In fact, in regards the smart meters there have been pilots and a national roadmap is expected, which may have an influence on Demand Response, too. Also, it shows that slowly, other provisions related to Demand Response can be expected to be dealt with, however, at the moment this does not seem to be a priority for the Regulator.

Thirdly, the technical barrier of the lack of meters, sometimes even individual meters (mainly for heat) is apparent. There is some move towards resolving this, and it is promising that the studies have found that smart meter system have an overall benefit and should be rolled-out.

Slovakia

Context

Electricity generation and wholesale activities are fully liberalized in Slovakia since January 2005, and therefore wholesale prices reflect market prices and are not regulated.

The Slovak electricity market is part of the former regional market, CENTREL with Poland, Hungary and the Czech Republic, later with Romania. The interconnection capacity for electricity was 61% in 2014 for Slovakia, which is well above the 2020 and 2030 objectives of 10 and 15% respectively[121]. Import and export prices are determined by bilateral contracts and since January 2005 there are no limits on the amounts of electricity that can be exchanged out of the domestic market. (Slovenské elektrárne 2014). The price convergence between Slovakia, Czech Republic, and Hungary increased from 11% (2012) to 82% (2014). Taking into account all energy products, Slovakia is a net importer (European Commission 2015).

One electricity provider, Slovenské elektrárne, owns 82% of the country's generation market, and is the main supplier of electricity for the three biggest regional distribution companies in Slovakia (ZSE, SSE and VSE) and also supplies electricity to large businesses. Slovenské elektrárne is also the main provider of ancillary services in Slovakia. While the company is not involved in the electricity transmission sector or in electricity distribution, SE Predaj, a 100% subsidiary of Slovenské elektrárne, operates in the SME distribution since 2009. In 2011, it started selling electricity also in the regulated household segment. (Slovenské elektrárne 2014)

The three biggest distribution companies (DSOs) are ZSE (West), SSE (Central), and VSE (East of Slovakia), which are 51% owned by the State, and the remaining shares are in private hands.

[121] October 2014 European Council conclusions

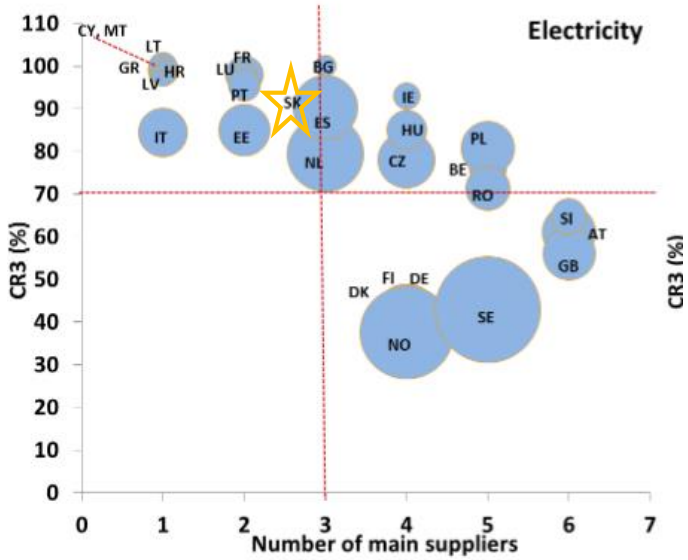


Figure3. Market share of the three largest suppliers (CR3) and the number of main suppliers and number of nationwide suppliers in retail markets for households. Source: (Pototschnig et al. 2015)

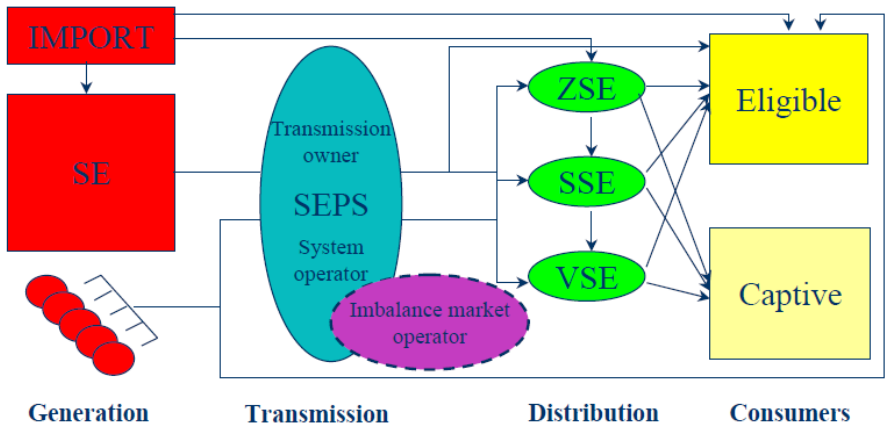
Market participants

The primary responsibility for the energy sector lies with the Ministry of Economy (ME).

The Slovak Board for Regulation is responsible for regulation strategy and management in network industries, whereas regulatory implementation is the responsibility of the Regulatory Office for Networks Industries (URSO). The Board and URSO were established in 2001 by the Act no. 276/2001 "On the Regulation of Network Industries", amended various times over the years.

Other key market participants include ((ERRA), n.d.):

- Slovenské elektrárne, a.s. (66% owned by ENEL SpA) with 70.43% of the market share in domestic electricity supply;
- 1 national, 100% state-owned TSO is SEPS, a.s. (Slovak electricity transmission system, Plc.). Its tasks include ensuring transmission system reliably, provision for the dispatching control of the system, its maintenance, renewal and development so that the reliable and quality supply of electricity to all transmission system users is ensured, as well as its parallel operation with the neighbouring transmission systems;
- 3 main regional DSOs (see above);
- ca. 160 small local distribution companies;
- 3 final suppliers of electricity for households and small businesses, as a part of vertically integrated utility performing simultaneously distribution system operator's function;
- Other market players: 134 license holders for generation (+2060 license holders for generation of up to 1 MW), 446 license holders for electricity supply (39 household suppliers).



4. Figure Basic market structure. For abbreviations, see in the text above.

Markets open to consumer participation

Legally all customers are eligible on the wholesale and the balancing markets since 1 July 2007 ((ERRA), n.d.), except for households.

However, to date, the DR system is largely populated by large consumers, who are in direct contractual connection with the main suppliers or the TSO and DSO. DR operation is therefore based on a bilateral contract, tailored for each case. These are mostly incentive-based contracts, i.e. consumption is based on a previously set profile and penalties are paid in case of failing to follow the profile. (JRC 2015)

Besides the predominant bilateral contracts, market participants, especially wholesale electricity traders, also use the short-term electricity market (day-ahead market, organized by OKTE), electronic exchange (organized by SPX) or auctions.

Smaller consumers do not participate in Demand Response in spite of the legal possibility, probably for technological reasons (JRC 2015).

Aggregators are not present on the Slovak electricity market, and they are not mentioned in legal documents. Therefore there are no possibilities for pooling of DR services. Balancing Service Providers participate on the market, and it is foreseen that they will develop into aggregators in the future (JRC 2015).

Entry to the market for all functions is dependent on a license. The granting of the license depends on technical and legal requirements as well as the payment of a fee. Licence is generally not required for generation and distribution of electricity for own consumption and for supply of electricity (including also its distribution) to third person(s) at a purchase price without profit margin. In these cases (i.e. where the licensing regime does not apply) a simple notification is sufficient.

Each market participant is responsible for its imbalances or may transfer this responsibility to a third party, e.g. to OKTE as the imbalance biller. Respective method depends on the position of the market participant. For example, wholesale electricity traders as electricity suppliers are generally obliged to transfer their responsibility to OKTE, while household customers' responsibility is usually transferred to the respective supplier and settled jointly as one balancing group. In case of renewable energy generating facilities with a total installed capacity of up to 1 MW (in case of solar energy up to 30 kW), the responsibility for imbalances is ex lege transferred to operators of regional distribution systems. (SeeNews 2014)

Regulatory status regarding Demand Response

The key regulation related to Demand Response include (based on (Michek 2015; European Commission 2015)):

- Energy Act No.251/2012 - It defines principal rights and duties of all participants in the electricity market; It is the basic transposition tool of the Third Energy Package and sets rules for electricity trading.
- Regulation No. 423/2013 defines market rules, Regulation on regulatory measures No.24/2013, Regulation on implementation IMS No.358/2013, Regulation on metering No. 3/2013
- Energy efficiency Act No.321/2014, Act on energy efficiency transposes the EED. This Act will impact on the structure of metering systems, metering data processing and provision of respective data.
- Regulation No.358/2013, Principal categorisation and requirements for the implementation of Intelligent Metering Systems (IMS) in Slovakia.

According to the Third NEEAP of Slovakia, URSO published the Methodology Guideline No 01/12/2013, Article V(2), which regulates electricity market stakeholders to create and make available systemic services for the management of consumption, in particular:

a) by shifting the load from peak to off-peak times by final customers, taking into account the availability of renewable energy, energy from cogeneration and distributed generation;

b) by energy savings from demand management;

c) by demand reduction from energy efficiency measures undertaken by energy service providers, including energy service companies;

d) by the connection and dispatch of generation sources at lower voltage levels;

e) by the connection of generation sources closer to the consumption site;

f) by the storage of energy.

Tariffs

Price regulation is applied in the fields of RES and CHP generation, generation from domestic coal, connection to the system, access to the transmission system and electricity transmission, access to the distribution system and electricity distribution, supply of electricity to vulnerable customers, provision of ancillary service, provision of system services, performance of the organizer of short-term electricity market activities, supply provided by a last resort supplier.

Freely Negotiated Tariffs:

Freely negotiated tariffs primarily apply to the supply of electricity to a company directly, except for small companies (companies with consumption up to 30 MWh electricity in preceding year). Also, electricity trading is based on freely negotiated tariffs. (SeeNews 2014)

Regulated Tariffs: (SeeNews 2014)

Certain electricity transactions are subject to regulated tariffs, such as supply of electricity to households, small companies and suppliers of last instance; production of electricity generated from renewable energy sources, electricity generated by cogeneration and electricity generated from domestic coal (in case of obligations in the general economic interest imposed by the Ministry of Economy); connection to a network; access to a transmission system and access to a distribution system; transmission and distribution; provision of system services and provision of support services; organisation of the short-term market.

Regulated tariffs are set in an administrative procedure by the Board of Regulation and the Regulatory Office for Network Industries.

Renewables with impact on DR

Electricity from renewable energy sources (RES) has been promoted through fixed feed-in tariff (FIT), which is set by URSO ((URSO) 2015; Mark Newbery and Silke Goldberg 2015). The set prices of electricity produced from RES and high-efficiency combined production have a major impact on the value of the applied tariff for system operation. Originally, the FIT were set quite high and resulted in a rapid proliferation of RES projects in 2010 and 2011, especially in the solar sector (Mark Newbery and Silke Goldberg 2015). To avoid an unstable electricity grid and high costs for consumers, the support for solar and wind projects was significantly decreased. Later biomass and biofuels became preferred and according to the Energy Law, the RES target for Slovakia for 2020 (14% share) should be achieved mainly by heat production and not by generation of electricity, support of which should gradually be lowered or removed.

New wind energy facilities are legally allowed, however, these must be first approved by the Slovak electricity TSO (Slovenská elektrizačná a prenosová sústava, a.s.), and the approval is very difficult (Mark Newbery and Silke Goldberg 2015). Furthermore, as of January 2014, the so-called "G-tariff" or "G-component" was introduced to be paid by all generators (including small/RES facilities) to the system operator for reserved capacity of its energy facilities within the transmission or distribution system. This significantly increases the transaction costs, and creates difficult entry for RES facilities.

Conclusions

Main markets enablers

The legal framework that transposes the Third Energy Package and the EED are in place, and provisions are set for Demand Response. Barriers still limit the actual functioning of DR.

Main market barriers

The key market barrier to DR is reported to be the lag in technological requirement, in particular the limited spread of smart meters (JRC 2015). A rollout of smart metering in Slovakia is still in the phase of discussions only (European Commission 2015), Although DSOs install smart meters on a voluntary basis, usually for energy-intensive customers.

The entry requirements hinder the proliferation of DR services. It is rather costly and cumbersome. Network tariffs include elements that increase the costs.

Liberalisation, although done at the legal stage, is not fully evolved. The power generation market is highly concentrated, and trading is mostly based on bilateral contracts and focused on large consumers.

Slovenia

Context

The regulatory framework of Demand Response (and consequently tariffs) is based on the "Act on the methodology determining the regulatory framework and the methodology for charging the network charge for the electricity system operators"[122]. The following measures are introduced:

[122] http://www.uradni-list.si/1/objava.jsp?urlid=201566&objava=2713

- Demand Response measures;
- Quality of Service regulation;
- Incentives for smart grid projects,
- Supporting of pilot projects from a field of Demand Response and demand side management, renewable energy management and storage of energy.

These measures ensure the cost-savings in networks according to criteria mentioned under paragraph 1 of the Annex XI. of EED.

Shifting of the load from peak to off-peak by final costumers taking into account the availability of renewables is not prevented by the regulation (for retailers), and not explicitly supported either (for network operators). Time of use tariffs and critical peak pricing are applied in Slovenia, and they are established under Article 98 of the "Act on the methodology determining the regulatory framework and the methodology for charging the network charge for the electricity system operators".

Market participants

TSO - The public company Electricity Transmission System Operator (ELES Ltd.) has the exclusive right to perform the public service of the transmission network system operator in Slovenia. The founder and the sole owner of the company is the Republic of Slovenia.

PMO - Borzen provides and facilitates coordinated operation of the Slovenian electricity system. It executes the activities of balance scheme management, recording of closed contracts, elaboration of indicative operating schedule, imbalance settlement and financial settlement of transactions, all connected with the aforementioned activities.

Markets open to consumer participation

Balancing Market

Participation of Demand Response (DR) in the balancing market is legal and possible in Slovenia in every reserve since 2014, however aggregation was limited to only the Tertiary Reserve until 2015 (SEDC, 2015), and the Secondary Reserve was opened for aggregated load in 2016 (ELES, n.d.) (**Error! Reference source not found.**). The contracted volume in 2014 was 12 MW, and 20 W in 2015.

At the moment, the Primary (and until 2016 the Secondary) Reserve was based on bilateral contracts between ELES and large industrial consumers.

Table 20. The status of balancing market products related to load acceptance and aggregated demand: Adapted from (SEDC 2015).

Balancing market (using ELES's terminology)	Total capacity contracted	Load access and participation	Aggregated load accepted
Primary Reserve	n/a	Y	N
Secondary Reserve	n/a	Y	Y*
Tertiary Reserve	348 MW	Y	Y (20 MW)

* newly opened

Furthermore, there is a cooperation agreement with Austria in place for secondary reserves, namely the Imbalance Netting Cooperation (INC).

Wholesale Market

Demand Response is not allowed in the wholesale market (SEDC 2015).

Ancillary services

ELES publishes tenders and/or auctions for the ancillary services and purchase of electricity for covering losses on the transmission network annually (ELES, n.d.). Network regulation enables participation of aggregated distributed consumers in ancillary services, according to Article 31, paragraph 4 of the "Act on the methodology determining the regulatory framework and the methodology for charging the network charge for the electricity system operators" (JRC 2015). At the same time, Demand Response providers are required to ensure 24/7 availability which is a major obstacle, and excludes a large number of potential (small) participants, thus limits the size of the load (SEDC 2015). The response time is 15 minutes, and it must be possible to deliver the service for a maximum 2 hours. The time between two activations must be at least 10 hours, with a maximum number of 2 activations per day. The minimum aggregated bid size is 5 MW. Activation is manual. (SEDC 2015)

Capacity Market

There is no capacity market and no plans to introduce it in Slovenia.

Status of regulation concerning aggregators

Aggregation is legal in the Tertiary Reserve, and now open for the Secondary Reserve, however, its size is small. There is only one entity that operates as an aggregator: the Virtual Power Plant (VPP), that is managed by the supplier Elektro Energija and the DSO Elektro Ljubljana, with CyberGrid as the system provider.

There are no clear rules related to contractual issues. If a party is interested in providing Demand Response services, it is required to obtain the consent of the BRP. However, demand-side flexibility is tolerated without written agreement in some cases. Apart from that, the aggregator is required to have a contract with the consumers (flexibility providers), and a market entity (where he will place this flexibility). There are no official compensation mechanisms in place to cover revenue losses of suppliers.

The single available official baseline (Baseline 1) is based on Demand Response unit schedule, where actual reduction is determined as the deviation of 'reduced' consumption from the scheduled 'regular' consumption. The companies can use their own baselines if they are accepted by the TSO, as done by VPP. In order to match schedules with the actual consumption, they are proportionally scaled to the last measured value before the activation.

According to Article 318 of the Energy Act[123], suppliers of electricity and heat and suppliers of solid, liquid or gaseous fuels to final customers shall be designated as obligated parties (hereinafter: obligated parties) to ensure the achievement of energy savings among final customers. These measures are not covered in the network regulation yet. (JRC 2015)

Main markets enablers

The most important driver of participation is that requirements for participation in the Balancing Market are acceptable and are sized to the capabilities of the Demand Response providers, except for the full-time availability criteria.

ELES, the TSO provides both utilisation and availability payments for the participation in the Tertiary Reserve. Availability payments are 38 000 EUR/MW, and utilisation payments reach 240 EUR/MWh. At the same time penalties for non-availability are high, with 20% tolerance level.

Currently, there are pilot projects supported by incentives to test Demand Response in relation to efficient use of networks and generation capabilities, based on Article 71. of the Act on the methodology determining the regulatory framework and the methodology for charging the network charge for the electricity system operators"[124]

[123] http://www.uradni-list.si/1/content?id=116549

[124] http://www.uradni-list.si/1/objava.jsp?urlid=201566&objava=2713

According to the Slovenian NEEAP (Ministry of Infrastructure 2015), the introduction of intelligent metering is outlined as a key factor for the participation of consumers in network efficiency. Grants will be provided from OP EKP 2014–2020 funds for the promotion of the development of intelligent distribution networks by upgrading the existing electricity infrastructure (smart metering, ICT support for smart services, etc.). Under this measure, the introduction of remote metering by actual consumption with two-way digital communication between supplier and consumer is expected as well as the introduction of dynamic innovative tariffs. These are expected to be important for the facilitation and encouragement of Demand Response services.

Main market barriers

The key barriers are related to the specificities of the country. The size of the electricity market is small with small volumes, and the number of accessible programmes is limited. In effect, there is not really a business case for Demand Response. For the moment, there are no programmes aimed at the network management.

A significant chunk of the market has not been available, namely the wholesale market and the Balancing market is more fit for large consumers due to the limitation on aggregators. The requirement of 24/7 availability is too difficult for participants that are potentially interested in the Tertiary Reserve.

Conclusions

Demand Response is allowed in the Balancing Market in Slovenia, but not in the Wholesale market. The capacity market does not exist in Slovenia. To the contrary of most countries which opened their product requirements to DR, Slovenia did not allow aggregated load in a wide scale, and limited aggregation to the Tertiary reserve, which now seems to open up in the Secondary reserve, too. This has resulted in the limitation of participants because small consumers are excluded, while large industrial consumers are the sole participants that can access the markets. There is only one aggregator in the market.

The business case is not evident in Slovenia for Demand Response, primarily because it is a small market. Both the TSO and the Demand Response providers need to improve their products in the future in order to compete with the conventional supply units.

Malta

Context

The Third Energy Package has been transposed by Malta in 2011, however with plenty of derogations.

Malta has no domestic resource of fossil fuels and no natural gas market however, the primary energy supply remains entirely based on fossil fuel. Ensuring the security of the supply side is therefore one of the main priorities for Malta. In order to secure the electricity supply and reduce the vulnerability of the sector, in April 2015 Malta was able to connect its power grid to the Italian transmission network which is part of the European grid. This interconnector allows Malta to exchange electricity with the Italian power market, importing and exporting electricity from and to Italy, ending its electricity isolation and, at the same time, achieving a diversified mix of energy sources.

Since there are no transmission systems and no transmission system operators in Malta, all the electricity consumers are served by Enemalta Corporation, the only distribution system operator (DSO). Enemalta Corporation is therefore responsible for the operational network security of the distribution system in Malta.

Capacity issues are not seen as a particular threat to Malta. Electricity is provided through three different sources and it is locally-generated at the Delimara Power Station and through other small-

scale domestic and industrial renewable energy installations[125]. Since April 2015 it is also imported through the Malta-Italy Interconnector[126].

The total combined installed capacity of Enemalta's plants is currently 599MW which includes 155MW from plants at the Marsa Power Station which was shut down in March 2015.

The local electricity sector is undergoing great infrastructural and operational changes and the technical capabilities and opportunities for Demand Response participation in the retail market are not yet clear to warrant a definition of technical modalities for participation.

Malta has a "Single Buyer Model" market and the production and distribution costs for the supply of electricity are covered by a single unbundled Tariff. The Tariff system is established by the Electricity Supply Regulations. The tariff system for the residential is based on a Progressive Tariff Model with a social component at the base, progressively increasing to emulate a Polluter Pays Principle. There is also an Eco-reduction bonus for consumers whose consumption is below average. In the residential sector there are no specific measures aimed at Demand Response. In particular for large non – residential consumers there are a Night Tariff and a Maximum Demand Charge, two measures which promote Demand Side Management helping to limit the infrastructural investments and operational cost on the network.

Markets open to consumer participation

The balancing between generation and demand is done by Enemalta Corporation as part of its daily generation dispatching operations to meet the demand. In the absence of large independent producers there is no market for balancing and ancillary services and as such, both of these services are provided by the facilities owned by Enemalta Corporation. There are no separate charges to customers for these services.

In Malta there are no wholesale electricity markets. Enemalta Corporation has effectively 100% share of the electricity retail market. The electricity retail market is not open to competition and therefore customer switching is not possible in Malta.

Dynamic pricing for Demand Response measures offered by networks or retail tariffs such as time-of-use tariffs, critical peak pricing, real time pricing and peak time rebates are still absent in the Maltese electricity market however, the electricity tariffs system differentiates between primary residences, domestic premises and non-residential premises[127]. The electricity market in Malta is constituted by a relatively high proportion of low consumption customers and a small portion of high consumption customers. Thereby dynamic pricing as a means of Demand Response will have to be distributed over a wide base of consumers to produce any meaningful contribution that might benefit both supplier and customers. The roll-out of Smart Meters is in an advanced stage; however the operator (being the only one) cannot consider offering dynamic pricing unless the deployment of Smart Meters is complete and fully commissioned. Further, the operator and regulator still have to evaluate the implications of the evolution of the local power sector and the role Demand Response may have in the new set-up.

[125] During 2012, there was a further increase in the generation capacity from renewable energy sources (RES) connected to the grid such that the total RES capacity installed by the end of the year was at 18MW. The increase in RES capacity consisted mainly of solar photovoltaic installations and the largest uptake took place in the residential sector due to the grant scheme that was launched in July 2011.

[126] The Malta-Italy Interconnector, inaugurated in April 2015, is capable of transferring to Malta an additional 200MW of electricity.

[127] The tariff structure provides the possibility for households to benefit from a percentage eco reduction on their electricity consumption bill on one registered primary residence.

Capacity Market

There is no capacity market and no plans to introduce it in Malta.

Status of aggregators

A market for Demand Response is not yet set up in Malta. Since the role of aggregators depend upon the participation of consumers in Demand Response programmes, Malta does not have aggregators.

Conclusions

Demand response in Malta is not yet developed mainly due to the lack of market pre-requisites conditions however, Malta should step up its efforts to diversify the energy mix and energy sources, notably by further developing renewable energy.

Although the rolling out of Smart meters has achieved over 90% of Enemalta's electricity meters and could encourage consumers to consume electricity more efficiently, with the current regulation and market set-up, Demand Response and demand management are not motivated for most of the consumers and producers.

Main markets enablers

Although Demand Response in Malta is not yet developed, the rolling out of smart meters can be viewed as a key factor for the participation of consumers in network efficiency.

Main barriers

The main barriers are related to the peculiarities of the country which has a relatively small electricity market with small volumes and no accessible programmes for Demand Response.

This is reflected by the monopoly of Enemalta, the only DSO in the market, the absence of transmission systems and transmission system operators in Malta and the fact that all the electricity consumers are served by Enemalta Corporation. Finally the Maltese electricity market is made by a high proportion of low consumption consumers and a small portion of high consumption customers therefore dynamic pricing as a means of Demand Response should be distributed over a wide base of consumers to produce any meaningful contribution that might benefit both supplier and customers.

Cyprus

Context

Cyprus is an island with no indigenous hydrocarbon energy sources. This means that its power generation system operates in isolation and totally relies on imported fuels for electricity generation. The security of energy supply can be considered as one of the main issues in Cyprus. The electricity system in Cyprus operates without cross-border links, however, in 2013 Cyprus signed a Memorandum of Understanding ("MoU") with Israel and Greece on cooperation in the fields of energy, welcoming joint projects to enhance the security of energy supply, sustainable development and cooperation among the countries in the region. In this respect, the three countries welcome the EuroAsia Interconnector project (a private initiative), which aims to create an electricity interconnector between Israel, Cyprus and Greece. This project will allow the export of electricity generated in the Eastern Mediterranean to the EU energy market through trans-European electricity networks.

The Third Energy Package has not yet been fully implemented by Cyprus. This is because in Cyprus only one company generates and supplies electricity therefore there is no wholesale market and

there are no cross-border links. For this reason Cyprus has been granted the status of a small isolated system under both the Second and Third Energy Packages.

Market participants

The Cyprus Energy Regulation Authority (CERA) is the independent national regulatory authority for the electricity and gas markets. CERA's role is to ensure proper regulation of the electricity and gas markets, to promote competition and to protect all consumers. CERA's responsibilities include approving tariffs, resolving disputes and securing a reliable electricity system.

The Cyprus Transmission Service Operator (TSO) was established in order to harmonise national law with the relevant European Directives for opening the electricity market. Its main duties are to operate, synchronise and manage Cyprus' transmission system accurately and to ensure the proper maintenance and development of the electricity network. The TSO also arranges the daily trading of electricity while at the same time supporting and promoting electricity generation from renewable energy sources.

The Electricity Authority of Cyprus (EAC) is an independent semi-governmental company established by the Electricity Development Law. The EAC had a monopoly on the generation and supply of electricity across Cyprus until 2004. EAC generates 90% of the electricity in Cyprus, although there are some producers that have entered the generation sector by producing electricity for their own use.

Markets open to consumer participation

Liberalisation of the Cyprus electricity market began under the provisions of the First Electricity Directive and the Second Electricity Directive concerning the common rules of the internal electricity market. As a result, 65% of the electricity market has been liberalised and opened to competition (with effect from January 2009) including all "non domestic" consumers being able to select their supplier according to what is in their best interest, thus ending the EAC's monopoly. Despite liberalisation of the electricity market, EAC remains the dominant producer of electricity and the owner of both the electricity transmission and distribution systems in Cyprus. The opening of electricity market to all customers has been delayed and it should be implemented by mid-2016[128].

As the EAC is the only company generating and supplying electricity, there is no wholesale market in Cyprus and there are no cross-border links. Due to the absence of competition, the wholesale and balancing market cannot yet function.

Status of aggregators

As Demand Response is not yet set up and the role of aggregators depend upon the participation of consumers in Demand Response programmes, Cyprus does not have aggregators.

Conclusions

Demand Response is not applicable in Cyprus due to the absence of market conditions. Furthermore, it could not be deployed until the electricity market will be fully liberalised[129]. On the other side, EAC has committed to support the integration of RES plants in the power generation system which could end Cyprus isolation and improve the security of energy supply.

[128] http://www.cyprusreporter.com/newsdetail/Opening-of-electricity-market-to-be-postponed-2602
[129] The electricity market in Cyprus should be fully liberalised by mid 2016.

Main barriers

The main barriers are related to the structure and the size of the electricity market in Cyprus which is small with small volumes, the absence of competition amongst networks and therefore the absence of accessible programmes. There is not really a business case for Demand Response in Cyprus.

The Baltic countries: Estonia, Latvia, Lithuania

Context

The context of the three Baltic countries is presented together, as these nations have – historically and geographically – a lot of features of their electricity system and markets in common[130]. The Baltic power system is highly integrated with the Unified Energy System UES power system, i.e. with the Russian electricity market, both in terms of physical connections and in terms of system stability. As a consequence, the Baltic power markets are synchronous with the UES market. One of the key goals of the near-future developments of the Baltic States is to increase the security of supply through full integration into the European electricity markets and by strengthening the interconnection capacity to the EU neighbouring countries. An overview of the Baltic Energy Market Interconnection Plan (BEMIP) is shown in the next figure.

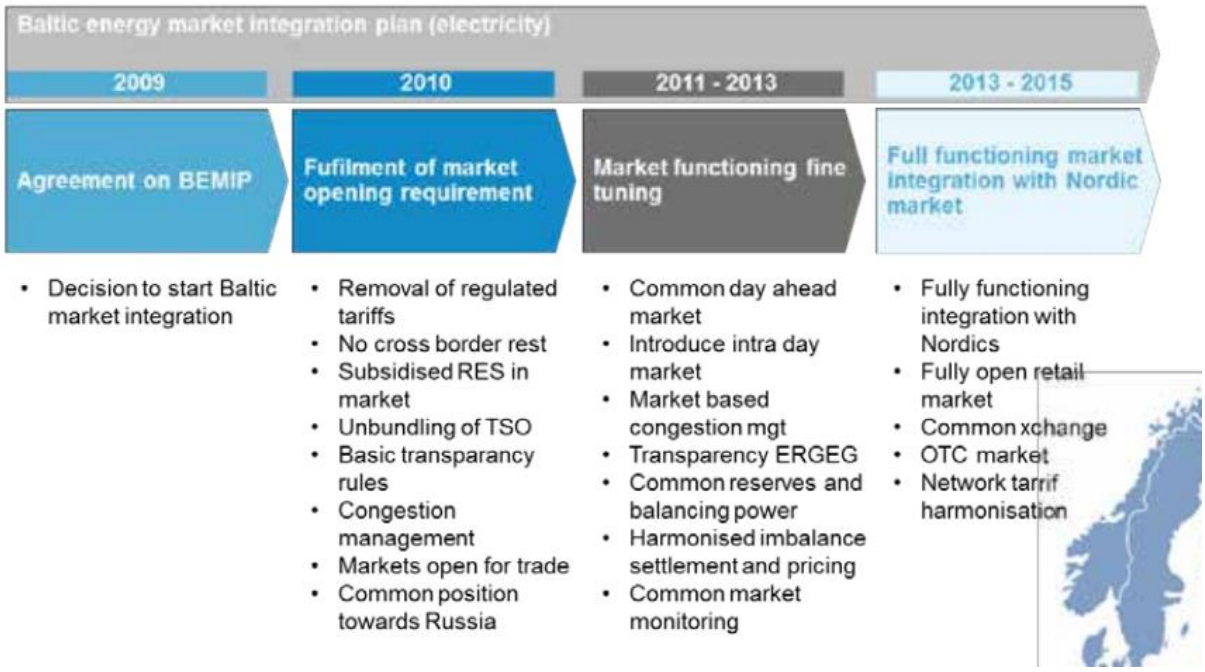


Figure 5. Overview of the Baltic Energy Market Interconnection Plan (BEMIP), with indications in relation to the Third Energy Package and electricity markets.[131]

The Baltic electricity markets can be characterized by the following features:

[130] Mainly based on the study Sarah Carter, Rahul Desai, Jimmy Forsman, Michel Martin, Oliver Pearce, Bradley Steel, Magnar Vestli (2015). Demand-side response as a source for flexibility. Pöyry: Tallin and on IEA 2016. Re-pwering markets. Market design and regulation during the transition to low-carbon power systems. Paris: OECD/IEA.

[131] Sarah Carter, Rahul Desai, Jimmy Forsman, Michel Martin, Oliver Pearce, Bradley Steel, Magnar Vestli (2015). Demand-side response as a source for flexibility. Pöyry: Tallin

- Members of the integrated Nord Pool market (along with Denmark, Sweden, Norway and Finland).
- Highly integrated with one another.
- Part of the UES Russian network i.e. 'synchronous'.
- Markets are relatively small (in terms of demand).
- Markets have historically been dependent on one power source in each market (oil shale in Estonia, hydro in Latvia and nuclear power in Lithuania) and one vertically integrated national utility.

A Memorandum of Understanding on a refined BEMIP extension plan was signed in June 2015, in order to proceed with the removal of regulated tariffs, separation of TSO activities and roles, removal of cross-border restrictions, establishment of market based constraint management as well as common reserves and balancing power market, full opening of the retail market and establishment of common power exchange for physical trade in Nordic and Baltic area. The Baltic TSOs also plan to desynchronise from the UES power system.

Estonia is broadly on schedule with its BEMIP process plan, while Lithuania and Latvia need to strengthen efforts.

Estonia

Context

Currently, Demand Response is very limited in Estonia, due to legal barriers. However, the government - and the TSO in particularly -, are exploring the possibilities and the potential of empowering DR, and have been preparing the ground for this.

The Estonian electricity market was de-regulated by January 2013, which openned new business opportunities for market participants, leading to competition in electricity generation and retail. However, functions related to the network infrastructure and transmission services have remained under monopoly.

Estonia is one of the European countries that is least dependent on energy imports. Oil shale is the predominant primary energy resource (providing about 85% of generated electricity), with RES increasing its importance[132].

The Estonian power system is interconnected with the power system of IPS/UPS of Russia, which is planned to be desynchronized by 2025. In 2012, the total capacity of installed power plants was 2647 MW, the peak demand is around 1600 MW and is expected to increase 1.8%/year during the next 10 years.

Furthermore Estonia has cross borders electricity connections with Latvia and Finland (via a 350MW sea cable Estlink1). In 2014 a second sea cable between Estonia and Finland (Estlink2) was completed, increasing the transmission capacity between the Baltic and Nordic countries.[133] Estonia has sufficient production capacity for covering domestic electricity demand and has the possibility to export electricity, mainly to Latvia and Lithuania.[134] There are no capacity issues. As regards the security of supply in Estonia, this was also improved through the construction of two emergency reserve power plants by the TSO , Elering AS.

[132] IEA. 2016. Re-pwering markets. Market design and regulation during the transition to low-carbon power systems. Paris: OECD/IEA.
[133] In addition to these links, further interconnections, namely between Estonia and Latvia (2020) are in the planning phase
[134] Sarah Carter, Rahul Desai, Jimmy Forsman, Michel Martin, Oliver Pearce, Bradley Steel, Magnar Vestli (2015). Demand-side response as a source for flexibility. Pöyry: Tallin.

The Estonian government and the TSO, Elering, have been intensively exploring the options to extend the use and application area of Demand Response during the last 1-2 years, and a number of background studies have been commissioned.[135]

Market participants

Elering is the TSO which is responsible for the Estonian electricity system. As the backbone of the Estonian energy system, its role is also to ensure conditions for efficient energy market operations and economic development. In addition to Elering, electricity producers and network operators such as Elektrilevi and Imatra Elekter are expected to be interested in lowering the peak load curve. Their interest is to reduce the need for additional electricity generating capacity, because it is very expensive and additionally increases the capacity of electricity networks. Until now only the major Estonian generator (Eesti Energia) and neighbouring TSOs have provided balancing services. The network operators have legal obligation to contribute to the roll-out of smart meters.

RES

The biggest share of the renewable electricity production in Estonia comes from the biomass and municipal waste using CHP plants. A few DR programmes using renewable energy sources are present in Estonia. Some aggregators of RES do offer services related to switching of power sources in building where accumulators or renewable energy production equipment are installed. Until now, the electricity system has been fit to absorb the growing amount of new installed capacity, and Demand Response has not been very interesting.

Markets open to consumer participation

Since consumers are able to buy their electricity from various sellers and ideally could choose from a variety of pricing options. Thanks to the shared Nordic Electricity Exchange Nord Pool Spot platform, electricity producers and consumers in Estonia have the opportunity to buy and sell electricity in a larger Nordic-Baltic market. This in turn enhances competition.

Balancing Market

The TSO, Elering has the obligation to ensure the security of supply and balance the Estonian power system. The amount of the production, consumption, export and import in the system depends on the portfolios of the balance providers and the balance plans they have submitted. There are 7 balance providers that operate on the Estonian electricity market[136]. The balancing market is governed by the responsibility rules and mutual obligations for balance providers set in the standard conditions of the electrical balance agreement.

The current rules that are relevant for RES and DR involvement in the balancing market are summarized in the next figure:

[136] The main ones are: Eesti Energia AS, Baltic Energy services OÜ, Latvenergo Kaubandus OÜ, Nordi Power Management OÜ and the Estonian branchof EGL Nordic AS

Rule	Estonia	Nordic (Regulating power market)
Commercial model	Bilateral agreements	Market-based
Settlement rule	Pay as bid	Marginal pricing
Activation rule	Merit order	Merit order
Minimum bid size	5 MW	10 MW
Product resolution	1 hour	1 hour
Full activation time	10 min	15 min
Gate closure	45 min before operating hour	45 min before operating hour
Aggregated loads allowed to bid	Not mentioned	Yes

Estonian and Nordic balancing market rules. Source: Sarah Carter, Rahul Desai, Jimmy Forsman, Michel Martin, Oliver Pearce, Bradley Steel, Magnar Vestli (2015). Demand-side response as a source for flexibility. Pöyry: Tallin.

At the moment, there is no Demand Response programme in the balancing market in Estonia. "The main issue with the existing balancing service is that it is not based on a market mechanism and it lacks of transparency how the prices are formed." Furthermore, it has been seen as a barrier that "currently most of the service providers are from outside of Estonia"[137].

However, it has been suggested that the role of Demand Response will become apparent in the Balancing Market when Estonia desynchronises the electricity system from IPS/UPS (Russia), in order to ensure its own reserve. The value associated with the use of DR for holding reserve is relatively high, especially compared to the (low) wholesale market use of DR.[138]

Wholesale Market

Estonia is covered by the Nordic electricity exchange area Nord Pool Spot. Although there is no explicit prohibition of DR, the lack of a clear legal framework, definitions, responsibilities and market functions act as a key barrier to its development. As a result, Demand Response has not taken place, although the studies commissioned by Elering indicate an interest from investors. Even for the future, studies do not indicate major interest in DR on the wholesale market.

Retail Market

According to the law, in the retail market in Estonia, all customers are eligible and free to choose their supplier and the price of electricity is set by competition among the sellers. Since the time of market liberalisation, most electricity customers in Estonia have switched electricity suppliers, while, electricity tariffs have also increased (between 30-55%).

[137] Using demand side management in energy-intensive industries for providing balancing power - The Estonian case study. Available from: https://www.researchgate.net/publication/261309948_Using_demand_side_management_in_energy-intensive_industries_for_providing_balancing_power_-_The_Estonian_case_study [accessed Jan 27, 2016].
[138] Sarah Carter, Rahul Desai, Jimmy Forsman, Michel Martin, Oliver Pearce, Bradley Steel, Magnar Vestli (2015). Demand-side response as a source for flexibility. Pöyry: Tallin.

Capacity Market

There is no capacity market for DR in Estonia.

Status of regulation concerning Demand Response and pricing

There is no specific legal framework for DR, nevertheless it is not directly prohibited either. The vague circumstances present a major barrier to the development of DR. On the other hand, according to the 3rd NEEAP of Estonia, the legislative framework legislation of this sector is managed by the Energy Department of the Ministry of Economic Affairs and Communications, and all detrimental incentives to the overall efficiency of the generation, transmission, distribution and supply of energy, or might hamper participation of demand response in balancing markets and ancillary services procurement have been removed.

The Estonian Government adopted the new **Energy Management Coordination Act** on 16 June 2016, which transposes all the legal framework for the EED. This opens the way forward secondary legislation, which should enable the dissemination of DR, as well as other EED-requirements in a few years.

There have been other relevant amendments to the electricity market legislation in Estonia, including:

- In January 2010 comprehensive amendments to the **Electricity Market Act** (the central regulatory framework) were adopted. These changes were largely related to the opening of the electricity market to all customers.
- In June 2012 amendments were enforced in the **Electricity Market Act**, which also harmonised other requirements arising from *Third Package* into the Estonian legislation.

As of January 2013 the Estonian electricity market was 100% opened and all types of consumers can choose the seller of electricity.

The document issued by the Competition Authority 'Integral methodology for the calculation of network charges for electricity' sets network charges. The methodology also prescribes that, as concerns costs, the Competition Authority may determine (through the conditions of an operating licence) an undertaking's development obligation for a specific period of time, in order to increase technical efficiency[139].

- Time-of-day tariffs, i.e. electricity retailers offer consumers packages with two (or more) rates. This tariff is widely used, and there is a tendency to move towards more and more real time hourly prices to reflect the smart meter roll-out.
- Therefore, dynamic pricing is gaining popularity.

Smart meters

Estonia has legal requirement to fully roll-out smart meters by the end of 2016. The roll-out will concern all types of consumers, and the expected scenario has increased the attention of investors and developers of smart meters technology, potential aggregators and DR providers.

Conclusions

[139] The Third National Energy Efficeincy Action Plan of Estonia.

While the use of DR currently is very low and non-sophisticated, the studies commissioned by the TSO indicate that the deployment of DR would be highly beneficial with low costs. A summary of a possible DR future is shown in the next figure:

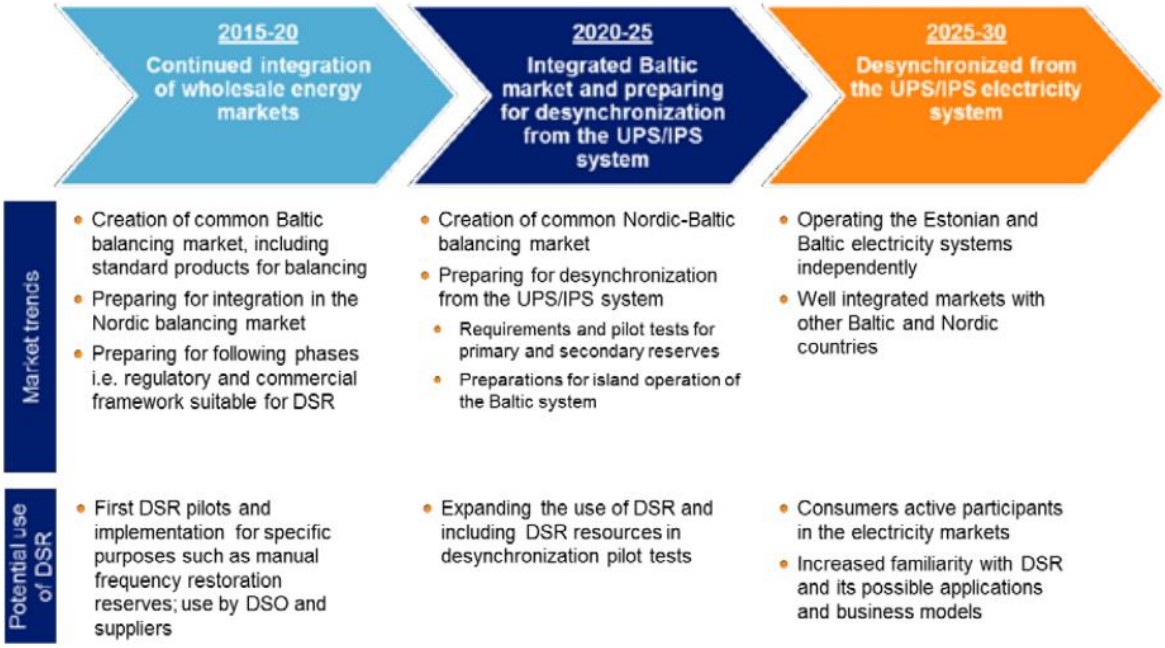


Figure 6. DR future in Estonia [140]

Demand response in Estonia can be deployed and consumers seem willing to participate in providing Demand Response services for the transmission system operator, who should use this information as an input for developing the necessary market entity for balancing services. Large electricity consumers have started to monitor the situation on the electricity market and plan their production according to the market situation[141].

Main markets enablers

- It is expected that when Estonia desynchronises from the IPS/UPS system, the value of holding reserves will increase greatly. To contribute to this, DR is expected to play a crucial role and deliver significant cost saving potential for the Estonian system. The value associated with the use of DR for holding reserve is relatively high, while the expected monetary value of DR in the wholesale market is rather low[142]. A stronger connection to the Nordic countries and the use of various types of production is likely to lead to price harmonization.
- Since the opening of the market in 2013 consumers are allowed to switch and select their electricity supplier, even though interest so far has been limited.
- The role of aggregators in the Estonian electricity market will be key to provide balancing services on the demand side e.g.: by monitoring the electricity balance. Aggregators support

[140] *Sarah Carter, Rahul Desai, Jimmy Forsman, Michel Martin, Oliver Pearce, Bradley Steel, Magnar Vestli (2015). Demand-side response as a source for flexibility. Pöyry: Tallin.*

[141] Cited in: Using demand side management in energy-intensive industries for providing balancing power - The Estonian case study. Available from: https://www.researchgate.net/publication/261309948_Using_demand_side_management_in_energy-intensive_industries_for_providing_balancing_power_-_The_Estonian_case_study [accessed Jan 27, 2016].

[142] Sarah Carter, Rahul Desai, Jimmy Forsman, Michel Martin, Oliver Pearce, Bradley Steel, Magnar Vestli (2015). Demand-side response as a source for flexibility. Pöyry: Tallin.

individual consumers and companies to reduce energy costs as well as to earn income through participation in energy trade by Demand Response programmes.

- The Nordic Electricity Exchange Nord Pool Spot (NPS) platform which covers the Baltic electricity market enhances competition among the electricity producers and consumers which, as a result, triggers competitive price for consumers.
- It is further expected that DR for the within-day or balancing timeframe will increase due to increased wind penetration, but only to a limited extent, given the flexibility of the neighbouring Nordic system. This means that the overall market volume for Estonian domestic generators and DR is expected to remain unchanged.
- The roll-out of smart meters will enable DR.
- DR has been evaluated in Estonia to provide value to the Estonian distribution system through relieving network congestion and allowing network investments to be deferred. However, the value was calculated as relatively low compared to the value associated with national level benefits from DR. [143]

Main market barriers

Since the liberalisation of the electricity market in Estonia, prices have increased steadily. The issue is that harmonized market rules have to be applied to everyone and consistently. The legislation that regulates the electricity market in Estonia must allow market participants to operate without obstacle. E.g.: lowering the participation cost in DR programmes.

While there is no explicit prohibition of DR in Estonia, the lack of a clear, transparent legal framework, including market rules, network rules and definitions hinders the willingness of investors to engage in DR even on a market basis. This environment is seen as instable.

The study by Elering collects the core barriers as seen by stakeholders.

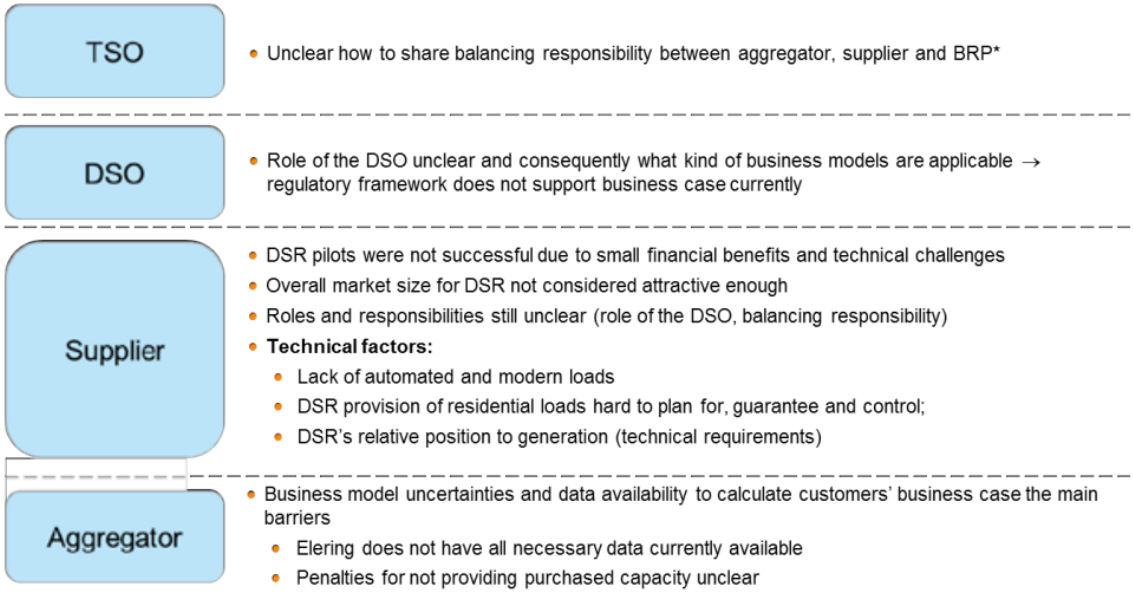


Figure 7. Stakeholder views on the barriers to DR in Estonia[144]

[143] Sarah Carter, Rahul Desai, Jimmy Forsman, Michel Martin, Oliver Pearce, Bradley Steel, Magnar Vestli (2015). Demand-side response as a source for flexibility. Pöyry: Tallin.
[144] ibid

Latvia

Context

Latvia was granted derogation from the Third Energy Package as an emergent gas market and it liberalised the electricity market in April 2014.

The Electricity Market Law, the Law on Regulators of Public Utilities as well as other legal acts which are in force in Latvia, allow the use of Demand Response and established the methodology determining the regulatory framework and the methodology for the calculation of transmission and distribution system service tariffs.

The Latvian national regulator, the Public Utilities Commission (PUC) is the multi-sector regulator active in Latvia. The state-owned company JSC "Latvenergo" dominates the field of electricity supply controlling around 90% of installed capacity for the generation of electricity in Latvia. The company offers services related to the import and export, and delivery of electricity to customers. The functions of the electricity transmission system operator are carried out by JSC "Augstsprieguma tīkls", the independent transmission system operator. The functions of the electricity distribution system operator are carried out by JSC "Sadales tīkls", the independent distribution system operator owned by Latvenergo.[145]

Network and retail tariffs

In Latvia there are no such incentives in distribution or TSO tariffs that are detrimental to the overall efficiency. Also there are no incentives in TSO tariffs that might hamper participation of Demand Response, in balancing markets and ancillary services procurement. National regulator verifies technically and economically reasonable system operator's costs that are necessary for effective provision of the system service. Regulator controls (ex-post) the quality of system services like losses. New customers are incentivized to choose corresponding capacity of new constructed connection – DSO is covering the cost of connection if the customer efficiently uses this capacity. National regulator approves DSO costs and tariffs, continuously checks operational efficiency (SAIFI/SAIDI rates, energy losses etc.) and sets new regulations and targets for efficiency.

Liberalisation

The electricity market was fully liberalised on the 01/01/2015 when the regulated end-users process were abolished however electricity tariffs remain high, when compared to EU levels.

Market participants

The state-owned company JSC "Latvenergo" dominates the field of electricity supply in Latvia, controlling more than 90% of installed capacity for the generation of electricity in Latvia. The company offers services related to the import and export, and delivery of electricity to customers[146].

The stock company "Latvijas elektriskie tīkli" is the owner of the transmission system which is a separate legal entity within the holding company JSC "Latvenergo".

TSO - Augstsprieguma tīkls AS is the leading Transmission System Operator which operates the electric power transmission network and ensures security of electric power supply in Latvia.

[145] http://www.ceer.eu/portal/page/portal/EER_HOME/EER_PUBLICATIONS/NATIONAL_REPORTS/National%20Reporting%202011/NR_En/C11_NR_Latvia-EN.pdf

[146] https://ec.europa.eu/energy/sites/ener/files/documents/2014_countryreports_latvia.pdf

In addition to this, it provides power transmission services based on the tariffs published and free third-party access to the transmission network. Augstsprieguma tīkls AS holds operational control of the transmission system and ensures its stable operation.

DSO - JSC "Sadales tīkls" is a separate legal entity within the holding company JSC "Latvenergo", covering 99% of electricity distribution.

Markets open to consumer participation

The electricity market became 100% open on July 1, 2007 when all customers became eligible to choose an alternative supplier of electricity. In 2010, 2,3% of the electricity customers that were in the free electricity market switched their electricity supplier.[147]

Network tariffs currently allow suppliers to improve consumer participation in system efficiency and customers are motivated to use limited capacity of network connection and, at the same time to consume more energy during off-peak time. TSO tariff is definitely not an obstacle for consumer participation in system efficiency, including Demand Response.

In Latvia the average energy consumption is quite low comparing to the capacity of the distribution system. Distributed generation is not covered with consumption (DG is located in areas with less consumption). That's why there are no cost-savings achieved in networks directly related to demand-side and demand- response measures and distributed generation in short and medium term. According to the distribution system service's tariff calculation methodology, tariffs are differentiated depending on time of day and day of the week in order to promote a more efficient distribution system.

Balancing Market

In Latvia balancing is ensured by TSO Augstsprieguma tikls AS (AST), the Latvian leading transmission system operator (TSO) responsible for power balance in the system as well as for providing of balancing services at the transmission network level. The TSO uses its existing capacity reserves in the electricity system and concluded agreements with Estonian (Elering) and Lithuanian (Litgrid) TSO, as well as with external balancing trader. All these procedures are set out in the Grid Code.

According to the Latvian Electricity Market Law[148] that sets the guidelines on the balancing arrangements among customers, producers and system operators, each electricity market participant shall be liable for the fact that the quantity of electricity sold by it in each trading interval complies with the quantity of electricity delivered to the system and the quantity of electricity purchased complies with the quantity of electricity received from the system. Thus, all Latvian electricity market participants, including those which intend to trade electricity in the Latvian bidding area of the Nord Pool Spot AS (NPS) Power Exchange, have to conclude the respective agreement on receipt of balancing services.[149]

Wholesale Market

The Latvian Wholesale Electricity market is heavily congested (more than 60% of time EE-> LV interconnection is congested). The electricity interconnections are represented by 2 Interconnection between EE-LV; 4 interconnections between LV-LT; 1 interconnection between LV-RU (see pic 1.

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147 http://www.ceer.eu/portal/page/portal/EER_HOME/EER_PUBLICATIONS/NATIONAL_REPORTS/National%20Reporting%202011/NR_En/C11_NR_Latvia-EN.pdf

148 Article 36 of the Latvian Electricity Market Law

149 http://www.ast.lv/eng/electricity_market/balancing_service_to_the_participants_of_nord_pool_spot/

below). Electricity generation in Latvia is almost entirely related to "Latvenergo" producing approximately 60% of total electricity consumption. The independent electricity generators are too small to offer significant volumes of energy for potential customers.

The network regulation and tariffs allow active usage of demand-side management and demand-response activities. Intraday market exists and it allow market participants to trade in close to real time horizon and in such way, to correct their generation/consumption plans taking into account the availability of renewable energy, energy from cogeneration and distributed generation. Energy producers are allowed to change their generation plans. According to tariff methodology system operators can differentiate tariffs. Tariffs may be differentiated depending on time of day and day of the week in order to promote a more efficient distribution system. Current network regulation and tariffs is not preventing network operators or energy retailers making available system services for Demand Response measures, demand management and distributed generation.

Figure 8. Source: http://www.ast.lv/eng/transmission_network

Retail Market

The electricity retail market in Latvia was officially opened on 01/01/2015 and is made up by 13 active traders and 5 traders active in the household segment. DSO has also designed and successfully implemented the trade platform/data sharing system and allows easy switching via DSO platform.

In 2015 the electricity retail market was reformed and it introduced a new centric model based on one bill to household customer - a universal service fixed price offer for one year – a protection service for vulnerable customers and in parallel a communication campaign at regional level was organized by ERRA (Energy Regulators, Regional Association).

Ancillary services

Network regulation and tariffs enables participation of aggregated distributed consumers in ancillary services. They do not prevent network operators or energy retailers making available system services for Demand Response measures, demand management and distributed generation. It is unclear whether in Latvia ancillary services are available to support DR programmes.

Capacity Market

Capacity market provide an additional incentive for developers and owners of generating capacity (i.e. power plants or Demand Response providers) to make their capacity available to electric markets where price signals alone would not. Capacity providers are paid on a kilowatt per year basis for the capacity that a power plant can generate or, in the case of Demand Response, the capacity of power that can be reduced. In Latvia is unclear whether DR can develop in the capacity market.

Status of regulation concerning aggregators

There are no clear rules related to contractual issues for aggregators.

Conclusions

Although the electricity market was liberalised, Latvenergo still remain the main electricity supplier for Latvian consumers. Dynamic innovative tariffs are expected to be important for the facilitation and encouragement of Demand Response services.

Main markets enablers

Current network regulation and tariffs can be considered one of the most important drivers in Latvia. They support dynamic pricing for Demand Response measures by final customers. In fact, time-of-use network tariffs are mandatory for large customers (above 800A) and also available for other customers. Real time (hourly) retail pricing is available for all customers.

By combining dynamic pricing systems such as time of use or real time pricing with smart meters technology, (timely and appropriate information feedback that can facilitate energy efficiency improvements and increase demand side flexibility mitigating peak loads), Latvia can achieve peak load shaving.

Main market barriers

Improper functioning of the wholesale electricity market is the key issue for the power sector in the country, along with the necessary renewal of outdated infrastructure. Challenges remain as regards smooth functioning of the regional electricity market.

Large part of the wholesale market has not been available to Demand Response and due to the limitation number of aggregators, the Balancing market is more suitable for large consumers.

Lithuania

Context

Lithuania has fully transposed the provisions of the Third Energy Package.

Its electricity market is vastly dependent on Russian power imports[150], particularly from the Russian Federation. In 2009, Lithuania retired its last nuclear reactor, which accounted for 77% of domestic electricity production and abruptly switched from an exporter of electricity to an importer of electricity. In 2015 interconnectors with Sweden and Poland have been finalized in order to decrease the shortage in generation, and to foster security of supply and wholesale market functioning.

The 700 megawatt (MW) transmission cable linking Lithuania and Sweden and the 500 MW cable linking Lithuania and Poland have drastically changed the future of energy politics in this Baltic state

[150] Lithuania imports almost 70% of its power from Belarus and the average price of electricity is among the highest in EU.

since the new transmission lines provide Lithuania with enough power to meet internal demand for all but a few hours of the day when power demand peaks.

Although Lithuania and the other Baltic states remain part of the Russian power grid for the time being, in the future they could be synchronized with the European Union's emerging transmission grid. This synchronization with Europe would give more responsibility to Litgrid AB, the electricity transmission system operator, which would then have to monitor the reliability of the grid and frequency spikes by itself.

Distributed electricity generation is still not very well developed in Lithuania except the launch of a campaign on PHV (Control of solar photovoltaic power) which took place between 2012-2014 and resulted in about 30 MW of total PHV capacity established by the government using the feed-in tariff obligation which was 3 times bigger compared to the retail electricity price. Hence becoming a cost-ineffective measure. On the other hand, the distribution of heat production by solar collectors and heat pumps combined with district heating option in public and residential buildings, seems to be much more promising. Energy savings deriving from Demand Response of distributed consumers by energy aggregators are still absent in Lithuania.

EPC and ESCOs are not yet developed in Lithuania however, a few steps have being made by a State Investment Development Agency targeting EPC actions in the public buildings.

Concerning the storage of energy, network regulation and tariffs do not prevent network operators or energy retailers making system services for Demand Response measures, demand management and distributed generation on organised electricity market. Lithuanian electricity system includes Kruonis Hydropower storage, which was coupled to work with Ignalina Nuclear Power Plant (decommissioned in 2010).

Dynamic pricing for Demand Response measures offered by networks or retail tariffs such as time-of-use tariffs and real time pricing are present in Lithuania. Electricity prices for consumers are state regulated. The DSO offers about 6 to 8 plans for consumers, which take into account: real time of consumption, 1 or 2 time-zones and minimum amount consumed with corresponding discount.

Critical peak pricing and peak time rebates are not yet available.

Concerning the removal of those incentives in transmission and distribution tariff that are detrimental to the overall efficiency (including energy efficiency) of the generation, transmission, distribution and supply of electricity or those that might hamper participation of Demand Response, in balancing markets and ancillary services procurement as required by Art.15 (4) Lithuania is not yet ready to comply with these requirements. Further, switching suppliers does not often occur and it is practically non-existent for consumers. However, final users can select a purchase plan according to their consumption needs and efficiency considerations.

Main markets enablers

Lithuanian consumers can switch electricity supplier since the beginning of 2015 (companies had this option since 2013), however, in practice they do not use this option due to the suppliers' lack of interest in doing a risky business with small customers. All electricity consumers from DSO are regulated by a state owned-tariff.

Main barriers

Lack of information and motivation to recognise the benefits that could be achieved with Demand Response programmes. There is no information related to the procedures, requirement obligations and price levels at which short term regulating service could be provided by TSO.

Conclusions

Lithuania should continue to promote competition through better integration of the Baltic energy markets. Since Lithuania is a fully functioning internal energy market, it should further support and encourage demand side resources such as Demand Response to participate alongside supply in wholesale and retail markets. This would mean to ensure that transmission system operators and distribution system operators should treat Demand Response providers, including aggregators, in a non-discriminatory manner, on the basis of their technical capabilities. MS should also promote the access to and the participation of Demand Response in balancing, reserve and other system services markets and should also define technical modalities for the participation of aggregators in these markets.

With the current regulation and market set-up, Demand Response and demand management are not motivated for most of the consumers and producers.

Chapter 6. Conclusion and recommendations for improving DR in MSs

In reviewing the continued progress of Member States toward opening markets for Demand Response, a uniquely European Model begins to emerge. In these successful cases, TSOs and regulators have used the deregulated and competitive market structure to empower providers and encourage market entry for consumers. These positive examples could be collected, highlighted and replicated across Europe.

While a significant portion of EU Member States have yet to begin their regulatory review with any seriousness, those who have looked to enable Demand Response are succeeding, despite continued barriers and remaining issues. This bodes well for the future of the market, particularly when we consider the overcapacity of generation now available in some Member States. The fact that consumer load is still able to compete successfully and reliably under these conditions is positive.

However, further clarity is required. A main finding of this report is that many national regulators find the process complex and confusing. For example, two repeated questions were:

- Is it enough that Demand Response is not specifically forbidden?
- Is it enough that retailers can aggregate consumer load?

They may also be unsure as to what is needed in order to either fulfil the requirements of the EED or what a positive market structure would include. As one regulator from an inactive Member State remarked *'But Demand Response is not illegal here, and no one wants it anyway – why bother with all these little technical changes? They are a lot of work.'*

The status of Member States regulation can be divided into roughly three groups.

First are those who have yet to seriously engage with Demand Response reforms. Obligatory provisions of the relevant EU Directives may have been transposed in name but not in fact.

Therefore while Demand Response may be 'legal' the MS have not adjusted their regulatory structures to enable demand side resources to participate in the markets, nor begun the process of defining the role of the independent aggregator and DR service provider, nor adjusted critical technical modalities. The result is therefore that though Demand Response is 'legal', there is no defined party to offer the service, no way to measure or pay for the service and no markets in which consumers or aggregators can sell demand side flexibility. Therefore, despite significant progress in certain EU Member States consumers and DR providers therefore remain barred from the majority of electricity markets in Europe.

These national regulators often state they find the development of the needed regulatory changes complex and confusing. It may also not always be understood how (or why) the regulatory environment would need to be changed at all. Regulators in Portugal, Spain, Italy, Croatia, the Czech Republic, Bulgaria and Cyprus and Malta have not as yet enabled DR or aggregation. However, Italy is aware of the issue and is undergoing a regulatory review, the status may change within 2017-18. Greece has created one auction-based program for large consumers and intends to open the market further. Poland has created two programs, however these are not successful today due to the low and controlled prices offered by the TSO.

Traditional supply approach in most of the CEE countries makes Demand Response to be considered as a hassle or an alien solution. Mostly, regulation text allows the participation of Demand Response (all or almost all), and EU Directives are transposed (word by word in Bulgaria, for example), but this does not translate into real practice. In Hungary, the regulator always keeps an overcapacity from traditional power stations that equal the expected load profiles from RES each day. In these regimes, the Regulator legally allows Demand Response to join the network, however when the licensing procedure takes place, in the end licenses are not approved on minor or questionable basis. There is no market pressure, and out of the very few applicants only 1 or 2 succeed to finally participate. For example, in Hungary, the only participant is a very flexible chemical factory, which has an additional on-site power generator (CHP), which was the way the Regulator was convinced about the low risk of participation in DR.

The wide-scale use of ripple control, an out-dated, but structurally built-in load-management system is seen as a key barrier to Demand Response in several CEE countries, such as Czech Republic, Slovakia and Hungary. Ripple control involves superimposing a higher-frequency signal onto the standard main power signal, in order to regulate the load from outside through a receiver that is attached to non-essential (heating and water-heating) devices. Currently, the control is in the hands of DSOs, in e.g. the Czech Republic, and the function as Demand Response is partial. In effect, the problem is that in case of ripple control, all the decision is in the hands of the supplier/retailer/DSO, while DR would allow the consumers to make decisions themselves. Ripple control works with dual-tariffs (or other time-of-use tariffs), which have developed in recent years, but responsiveness is far below from DR. In addition, this technology is not compatible with smart meters, increasing the cost-benefit ratio of this introduction significantly in the affected countries.

Finally, in many of the Central Eastern countries (e.g. Bulgaria, Croatia, Hungary), and all of the Baltic countries, the implementation of the Third Energy Package in practice and a full liberalisation of the electricity markets are lagging behind. Only, after full unbundling and increasing competition, would it be possible to start developing the regulating market, which could make it more attractive for a wider range of customers to provide regulating and/or emergency reserves. In all of these countries, at least some of the prices are regulated, especially those of households and small consumers.

The second group of Member States are in the process of enabling Demand Response through the retailer only. This is an important choice – due to the fact that the customer will not be offered a clear value for their flexibility - rather they will receive this bundled with their electricity bill. They either need to reject the entire package or accept. However it is difficult or impossible for them to know what they are in fact rejecting/accepting as they will very rarely (if ever) have a fully transparent offer[151]. It also limits market offerings to those that are positive for the **retailers** in a given country – which is often not be the same as those which would benefit the **consumer**.

These Member States limit aggregators to the role of service providers to retailers rather than independent parties providing independent offerings to consumers. The Nordics, the Netherlands and to a certain degree Austria, are in this group. Germany is considering enabling independent aggregation but a formal decision and key regulatory adjustments are yet to be made.

[151] This is not because the retailer will be looking to 'hide' value – rather the fact that the customer engages in DR will impact several aspects of the retailer's business model, their balancing costs, their company earnings from generation, network tariffs. The DR offering is therefore joined to the cost of the customer's electricity. It is not transparent and separated.

The Nordics have put in place Smart Metering and a liquid wholesale market. They have also performed regulatory reviews, which map market entry barriers for new entrant retailers and made dynamic pricing available to residential consumers. They have also enabled full aggregation of consumer load. Prequalification for participating in a market is therefore measured at the aggregated pool level, rather than for each consumer individually- an important enabler of Demand Response. This is positive, however only retailers can provide aggregation services freely, and unfortunately the business model issues for retailers concerning Demand Response remain the same in the Nordics as anywhere else and therefore growth will continue to be slowed. Also while the Finnish TSO and regulator have made progress in adjusting other technical modalities to allow Demand Response, Sweden and Denmark have not as yet opened the market sufficiently to allow market entry even for retailer driven DR.

Table 21. Overview of current status within EU Member States:

	Ancillary services markets open to participants	Balancing markets open to participants	Wholesale open	Aggregators	Tech modalities adjusted	RESULT
Austria	Most markets open to ALL with limitations for aggregators	retailer only	retailer only	Retailer only	Yes with significant barriers remaining	Active participation of large industrial in balancing market.
Belgium	Most markets open to ALL	retailer only	retailer only	Yes (under development)	partial but innovative	Active participation of large industrial and some commercial in balancing market. Limited retailer activity wholesale market
Bulgaria	No DR at the moment	No	No	No	No	There is a major lag with liberalization and lack of competition
Croatia	No	Legally yes, in reality no	Legally yes, in reality no	No (no consideration)	No	The energy sector is concentrated with one single company, liberalization progress is slow.
Cyprus	No DR at the moment	No	No	No	No	Absence of competition in the energy sector
Czech Republic	No (though ripple control participates)	Legally yes, in reality no	Legally yes, in reality no	No	Significant technical barriers, CBA for SM is negative	Suboptimal solution of ripple control remains as a major obstacle
Denmark	ALL (with limitation for aggregators)	retailer only	retailer only	retailer only	Not yet sufficient to function	Little significant participation in any market by any group
Estonia	Unclear	Yes, but not used	Yes, but not used	No	Roll-out of SM by end of 2016	No participation in any market by any group, although legally open
Finland	ALL (with limitation for aggregators)	retailer only	retailer only	retailer only	Yes - partially	Participation of large industrial and commercial and some residential in balancing market. Limited participation in wholesale through retailer.

	Ancillary services markets open to participants	Balancing markets open to participants	Wholesale open	Aggregators	Tech modalities adjusted	RESULT
Sweden	ALL (with limitation for aggregators)	retailer only	retailer only	retailer only	Not yet sufficient to function	Little significant participation in any market by any group
France	Most markets open to ALL	ALL	ALL	Yes	Yes with significant barriers remaining	(Limited) participation of all consumer groups in all markets
Germany	retailer only (severe limitations aggregators)	retailer only	retailer only	retailer only	Not yet sufficient to function	No significant participation in any market by any group
Greece	One program open to large consumers only	No	No	No (under review)	Yes for one open program	Participation of qualified large industrial in one balancing market program
Hungary	No (though ripple control participates)	Legally yes, in reality no (competition with ripple control)	yes (but very difficult to get license)	In theory possible, no examples	partial	One DR company on the wholesale, and 8 VPPs
Ireland	Two markets open to ALL	retailer only	retailer only	Yes	partial	Participation of large industrial and commercial in balancing market
Italy	No (under review)	In theory retailers are able	In theory retailers are able	No (under review)	No (under review)	No participation. (Single Existing program is not in full use and is not market based)
Latvia	Unclear	Unclear	Yes	Unclear	Not yet	Participation in the wholesale market
Lithuania	Unclear	Unclear	Unclear	Unclear	Not yet	No significant participation in any market by any group further support and encourage demand side resources such as Demand Response to participate alongside supply in wholesale and retail markets
Luxembourg	No	Legally yes, but no participants	Legally yes, but no participants	No	No	No DR used mainly due to technical/procedural reasons because of the interconnectedness with Germany
Malta	No	No	No	No	No	No regulatory framework for participation of DR
the Netherlands	Most markets open to retailers only	retailer only	retailer only	retailer only	Yes	Participation of industrial and commercial in balancing and limited wholesale
Poland	Two programs open to large consumers only	In theory retailers are able	In theory retailers are able	no (Unrealistic also for retail)	not sufficient to function	Very limited participation in one balancing program by qualified large industrial consumers

	Ancillary services markets open to participants	Balancing markets open to participants	Wholesale open	Aggregators	Tech modalities adjusted	RESULT
Portugal	No	In theory retailers are able	In theory retailers are able	no (Unrealistic also for retail)	No	No participation
Romania	No	Legally retailers are eligible	Legally retailers are able	Not even mentioned	No	No DR participation
Slovakia	N/A	Legally ALL, but households	Legally ALL, but households	Legally ALL, but households	No, which is a main barrier	Very low DR participation, only large consumers
Slovenia	Yes, All	Yes	No	Limited	Partial	The business case is not evident, thus DR is limited. Aggregation has been restricted.
Spain	No (no competitive programs)	In theory retailers are able	In theory retailers are able	no (Unrealistic also for retail)	No	No participation (Single existing program is not in actual use and is not market based)
the UK	Markets open to ALL	retailer only	retailer only	yes	partial - semi functional	(Limited) participation of all consumer groups in all markets

Germany does not yet enable independent aggregation and has made little progress in adjusting technical modalities to allow market entry for demand side resources. Added to this, the structure of their network fees still penalise (fines) large consumers who participate in the programs, while smaller consumers are never provided the opportunity as the metering infrastructure is not in place and/or the cost of entry is too high. The government is aware of the issue and is performing a regulatory review.

The Netherlands does not enable independent aggregation. However, it has succeeded in opening the balancing market to consumer participation through the BRP. Beyond the balancing market there is little activity today and little aggregated Demand Response in any Dutch market.

The Austrian TSO and regulator have established innovative market structures, which encourage competitive consumer participation, and allows Demand Response to participate alongside supply in the ancillary services market. They also have looked to open the market to new entrants by lowering the cost and risk of becoming a BRP. This is not fully successful, but is an interesting solution and has enabled 4-5 new entrants to provide services. The technical modalities in place still cause entry barriers, particularly in the area of punitive communication requirements (such as a requirement for a €10,000-€20,000 dedicated telephone line to each consumer) and onerous pre-qualification procedures.

The third group of Member States that enables both Demand Response and independent aggregation includes Belgium, France, Ireland and the UK. Belgium and France have both defined the roles and responsibilities around independent aggregation.

In France this work is completed and aggregators participate in every open market. The standardised framework is described in the Methodology section of this document, it creates standardised processes which allow the aggregator/consumer direct access to market without requiring the permission or involvement of their potential competitor, the retailer. The process defines: volume measurement criteria, data exchange procedures, and payment formulas to allow for smooth payment of sourcing costs to the retailer/BRP. Though issues remain, the system has created one of the most dynamic Demand Response markets in Europe.

The technical modalities remaining in the balancing and ancillary services markets still cause entry issues and are under continued review by RTE, who has already made significant adjustments. More complex issues remain within the FCR (*Primary Control*) and FRRa (*Secondary Control*) and Capacity market design. In all three of these markets (for different reasons), EDF is or will be both the main buyer and provider of resources. This causes obvious conflicts of interest issues and entry barriers for new entrant providers, though aggregators have contracted successfully with EDF to provide FCR and FRR resources. Within the FCR and FRRa it would be possible for RTE to purchase the resources, as they are the party in charge of this market and the final user of the resource. This would solve the structural issue. The Capacity market design has several important elements encouraging and enabling Demand Response and aggregation, though the issue of a single main purchaser and provider is likely to remain.

The Belgium Ancillary services markets are open to independent aggregators and Demand Response. The technical modalities have been adjusted to enable and encourage Demand Response within the ancillary services markets. Access to the balancing and wholesale markets remains problematic. Discussions are underway to create a standardised process between aggregators and BRP/Retailers. When these are completed (2016) the path to market should significantly improve for consumers and aggregation service provides.

In Great Britain the ancillary services market is open, and the regulator has allowed aggregators free access, despite the fact that the role is yet to be defined. Therefore, both retailers and aggregators now actively provide services to residential, commercial and industrial consumers when this is possible within the given market structures. GB is also rolling out Smart Meters and encouraging both DSOs and retailers to create innovative services. The market is dynamic with many small technological start-ups also benefiting for GB's healthy financial market to establish companies and create innovative solutions[152]. That said, the introduction of a Capacity Market structure which heavily favours generators, has been a significant set-back for Demand Response in GB. Fair and open Capacity Markets can provider a critical source of investment stability for Demand Response, however due to the fact that the market structure in GB presents entry barriers, within every level of the market structure (from the structure of the auctions to the measurement of load) Demand

[152] Access to capital is an important enabler of British start-ups, a critical resource that can be almost entirely missing in other EU Member States.

Response providers now have to compete with a generation fleet benefiting from approximately 1 billion in subsidies that they do not receive.

Demand Response providers and small independent retailers interviewed also voiced frustration at a lack of full representation during key meetings on market design. Similarly the STOR market structure was changed in a manner which lowered the earnings of consumers and encouraged the entrance of older generators. A large portion of demand side flexibility and approximately 9-10 aggregators left the STOR market in 2014-15 as a result, lowering the creation of new demand side capacity. Aggregators interviewed voiced the hope that with the new government, a more constructive dialogue between providers and policy makers might be possible. Several aggregators are already successfully engaged with National Grid and providing Ancillary Services using everything from residential to industrial loads.

The Irish market is centrally dispatched and therefore relatively simple to access for aggregators, as the TSO is in full control of the market they are able to ensure the retailer and BRP are not thrown out of balance by the Demand Response activation. There are two ancillary service markets open, however the frequency market and the balancing and wholesale market are not yet accessible. Today technical modalities have yet to be fully adjusted in order to enable aggregation or DR. This includes for example insisting that each consumer undergo an expensive pre-qualification process rather than measuring and qualifying the aggregated pool.

Innovation and Best Practice

Despite the barriers remaining today, in 2013 Europe was almost entirely shut to Demand Response. Significant progress has therefore been made between 2013 and 2015. Europe's energy market is unique, and there is the opportunity to create unique solutions combining competitive market structures with the decarbonisation agenda. This review has provided new insights on key success criteria for Demand Response which are in line with and benefit from, Europe's competitive market design. Below is a list of positive developments in Member States. No one Member State yet contains all of these elements, however they are complementary and could well be combined as a repeatable template for success.

Template for enabling aggregated Demand Response:

A rough template of a dynamic market structures, encouraging flexibility resources and Demand Response:

Market Structure Elements and Aggregation:

- **Open Wholesale, Balancing, Ancillary Services** and eventually, the **Capacity markets.** (France is the first and only Member State to open its wholesale market to aggregated Demand Response.)
- **Both Energy and Availability Payments Made** in at least 1 ancillary services market: the customer is paid for providing capacity to the system. This allows for investment security and encourages participation. (Multiple Member States provide this)
- **Frequent auctions** (Austria):

- Weekly auctions for capacity payments: the weekly bidding for the customer's availability payment allows the customer to calculate their availability on a weekly basis taking into account factors such as vacations, orders, weather, etc. For example, tn an annual bidding process customers and aggregators have to bid according to their lowest availability level for the entire year. The weekly bidding is therefore an important enabler.
- Daily energy auctions – mean that the consumer can set the price for that day's availability.

- **Appropriate Network Fees:** efficiency is encouraged by not penalising consumers for participating in Demand Response, and changing their consumption profile. For example, the Austrian DSOs separate balancing energy from normal consumption when calculating network charges, and charge for the balancing energy at a much lower rate.
- **DSOs encouraged to enable energy efficiency and Demand Response:** in the GB the regulation surrounding the payment of DNOs has been fundamentally adjusted and they are now able to benefit from improving the efficiency of their systems, including through demand side program development. This mechanism is unique to GB today but could be replicated in other Member States.

- **Matching Needs of Markets to Capabilities of Consumers:**
  - Example Belgian Frequency Market: The market is divided into three parts, part 1 is a symmetrical program – suitable for generators.
  - Part 2 and 3 are **asymmetrical programs,** one for increasing and the other for decreasing consumption, a critical enabler of consumer participation as consumers will rarely be able to increase and decrease consumption symmetrically.
  - Part 2 and 3 are activated between + / - 100-200mHz allowing consumers to balance the larger changes in frequency. This solves two issues – 1) consumer load is well suited for following large changes in frequency, often at a lower cost than generation 2) the larger shifts means that the consumer is activated less often. *This is an example of a market design which is moving away from a generation centric model and endeavouring to capture the strengths of both resources.*

- **Aggregation:** The **standardised process between BRPs and aggregators** is a significant enabler as it creates the framework by which aggregators can have a clear path to market (France, Belgium). This Framework includes:
  - *Volumes*: Standardised processes for assessment of the traded energy[153].
  - *Compensation*: For markets where there is a significant energy component (balancing and wholesale) a price formula to calculate the price for the transferred energy is needed. This is energy the retailer bought which the consumer does not consume because they are participating in Demand Response. There is widespread acknowledgement that the retailer does indeed lose income through the balance

[153] i.e. the transfer of energy between the BRP's and the aggregator's balancing groups following a Demand Response dispatch.

responsibilities during a Demand Response activation by an independent aggregator.[154] In the case of demand reduction, the aggregator pays the BRP/retailer; in the case of demand enhancement, the BRP pays the aggregator. This price formula should reflect as closely as possible the average sourcing costs of the energy transferred.

- *Data Exchange:* A clear definition of what data needs to be provided to the BRP through the TSO, to ensure both the aggregator and the BRP can fulfil their obligations whilst not having to share commercially sensitive information.
- *Governance structure:* An appeals process and an appeals body, in case any issues need to be resolved.

Technical Modalities, which take into account the capabilities of participants:

- **Enable Full Aggregation of Consumer Load** (Finland, Denmark, Sweden, BG, France...)**:** Qualification for participating in a market is prequalified and measured at the aggregated pool level, rather than for each consumer individually. This is an important enabler as it allows the aggregated pool of consumer load to be treated as a single resource, maximising the group's joint potential. It also allows the aggregator to act as mediator for the consumer, protecting them from onerous and complex technical pre-qualification measures. It is questionable that some TSOs in Europe are capable of accepting pre-qualification of the pooled load and others are not. They should all accept it. If 4-5 can do it the others can as well, and this critical barrier could be removed from all Member States.
- The **baseline methodology** is appropriate and realistic – based on consumer capabilities and metering data (Greece, GB, France among others)
- The **payment criteria** is clear and transparent and pays a full price for services rendered (Greece, Austria, Belgium, France, GB, Nordics...)
- **Pay as Cleared**: (this element is already included in the Network Codes today) This means that all market participants are paid the clearing price for the market, even those that would have provided resources for less. This has a benefit as the low cost resources multiply, gradually lowering the clearing price.
- **Granular Availability Requirements:** For example, the Austrian Secondary control market is split into three time periods meaning that a consumer available during the day can be paid for this availability and does not need to be available at night as well, for example.
- **Short Call Duration** in the reserves markets: should be 1-2 hours in alignment with actual market requirements.
- **No minimum** required size for consumer participation (Finland, Denmark, Sweden).

[154] According to the market modelling of the SEDC, using the hourly market prices (winter 2013-14) - in France alone, 1 GW of Demand Response activated 500 hours a year would lose the French generators **€469 million** a year in reduced wholesale market revenues (due to the lowered clearing prices)**,** while sourcing costs would come to only **€27 million** (according to EDFs own calculation methodology). At the same time the **payment** of this €27 million by French aggregators to the retailer would remove 85% of their margin for participating in the wholesale markets - effectively killing their business.

Therefore there is reason to believe that the argument of large retailers insisting on the payment of sourcing costs is not over the €27 million a year but to protect against the €465 million of potential losses a year to the generation assets. (In Germany the generation losses through the reduced clearing price would be €959 million a year against €27million for sourcing costs). The sourcing cost issue therefore justifies careful analysis

- **Real-time prices in the balancing market** communicated to consumers. This allows them to react to these prices and earn off of their ability to help balance the system. (the Netherlands)
- The **capacity payments** within the capacity market support investment security and consumer engagement. (Ireland)

No single Member State has succeeded in incorporating all the elements above in their markets. However these elements complement each other and bring about a constructive unity. They are in fact a **repeatable template** for realistic and positive enablers of Demand Response and Aggregation in Europe[155]. Today this template is not communicated to regulators fully. While some TSOs and regulators clearly understand Demand Response and aggregation well, and have even succeeded in encouraging growth, others require further information.

TSOs and regulators in for example, Belgium, France, Austria, Great Britain and elsewhere, have been making a concerted effort to enable Demand Response to enter the markets within the competitive and de-regulated framework. Some of these solutions are innovative and capture the capabilities of demand side resources in a uniquely European manner. What is now needed is for these solutions to be **unified**, **communicated** and **replicated across Member States**. The European Commission will play a critical role in this process.

[155] The work of EG 3 within the Smart Grid Taskforce has also made important progress in creating a template. That said, there would be a place for highlighting and repeating existing best practice, which are demonstrated and proven.

References

Austrian Energy Agency (AEA). 2014. "Romania." *enerCEE.net*. http://www.enercee.net/countries/country-selection/romania.html.

Alfoldi, Gabor, Richard Balog, Andrea Bobak, Zoltan Feleki, Laszlo Galambos, Peter Kertesz, Imre Kozma, et al. 2014. *Statistical Data of the Hungarian Electricity System 2014*. Budapest, Hungary: Hungarian Energy and Public Utility Regulatory Authority (MEKH) and MAVIR Hungarian Independent Transmission Operator Company Ltd. http://www.mavir.hu/documents/10258/45985073/VER_Stat_2015_1223MAVIR.pdf/54105c7e-fc2e-439e-9779-5e468a28f5ae.

ANRE. 2015. "National Report 2014." Bucharest, Romania.

Bulgarian Government. 2015. "Energy Act." State Gazette, SG No. 107/9.12.2003; and State Gazette No. 17/06.03.2015.

Cojocaru, Monica, and Anca Velicu. 2014. "Romania: Transparency in Energy Trading at What Price?" *Schonhett Roadmap14*. http://roadmap2014.schoenherr.eu/romania-transparency-energy-trading-price/.

European Commission DG Energy(DG ENER). 2014. *EU Energy Markets in 2014*. Adapted version of the Commission Staff Working Documents SWD (2014) 310 final and SWD (2014) 311 final accompanying the Communication «Progress towards completing the Internal Energy Market» COM (2014) 634 final of 13 October 2014. Luxembourg: Publications Office of the European Union.

European Commission(EC). 2013. "Findings and Recommendations Related to the Bulgarian Energy Policy." http://www.sofia.diplo.de/contentblob/4047990/Daten/3321520/EUKommissionAnalyseBGEnergiesystem.pdf.

———. 2015. "Press Release - Antitrust: Commission Accepts Commitments by Bulgarian Energy Holding to Open up Bulgarian Wholesale Electricity Market." December 10. http://europa.eu/rapid/press-release_IP-15-6289_en.htm.

European Commission, Joint Research Center (JRC). 2015-2016. Online survey and phone interviews with electricity experts and NRAs. Survey was available at: https://ec.europa.eu/eusurvey/runner/Demand_Response_EED_Art_15

ELES. n.d. "System Services." http://www.eles.si/en/for-business-users/descriptions.aspx#system-services1.

Energy Community Regulatory Board. 2012. "Electricity Balancing Models in the Energy Community." Vienna, Austria: Energy Community. https://www.energy-community.org/portal/page/portal/ENC_HOME/DOCS/1496181/0633975AB8F37B9CE053C92FA8C06338.PDF.

Energy Regulators Regional Association(ERRA). 2016a. "Membership Profiles - Bulgaria." Accessed January 25. http://erranet.org/AboutUs/Members/Profiles/Bulgaria.

———. 2016b. "Membership Profiles - Croatia." Accessed January 25. http://erranet.org/AboutUs/Members/Profiles/Croatia.

———. n.d. "Membership Profiles - Romania." http://erranet.org/AboutUs/Members/Profiles/Romania.

———. n.d. "Membership Profiles - Slovakia." http://erranet.org/AboutUs/Members/Profiles/Slovakia.

European Commission (EC). 2015. "Commission Staff Working Document - Country Factsheet Slovakia, Accompanying the Document "Communication from the Commission to the European Parliament,The Council, the European Economic and Social Committee, the Committee of the Regions and the European Investment Bank." European Commission.

http://ec.europa.eu/priorities/energy-union/state-energy-union/docs/slovakia-national-factsheet_en.pdf.

Grozdanov, Iliya, and Dinova Rusev and Partners. 2014. “Electricity Regulation in Bulgaria: Overview.” *Practical Law*. February 1. http://uk.practicallaw.com/2-523-7911?q=*&qp=&qo=&qe=.

International Energy Agency (IEA). 2014. *Energy Supply Security: The Emergency Response of IEA Countries - 2014 Edition*. 2014 Edition. Paris, France: IEA/OECD. https://www.iea.org/publications/freepublications/publication/ENERGYSUPPLYSECURITY2014.pdf.

Mark Newbery, and Silke Goldberg, eds. 2015. *The European Energy Handbook 2015 - A Survey of Current Issues in the European Energy Sector*. Herbert Smith Freehills LLP.

McKenna, Eoghan. 2013. “Demand Response of Domestic Consumers to Dynamic Electricity Pricing in Low-Carbon Power Systems.” Doctoral Thesis, Loughborough, Leicestershire, UK: Loughborough University. https://dspace.lboro.ac.uk/dspace-jspui/bitstream/2134/12120/4/Thesis-2013-McKenna.pdf.

Michek, Martin. 2015. “Approach to Smart Technologies in Our Country [CZ], in Slovakia and in Europe.” April. http://www.cez.cz/edee/content/file/o-spolecnosti/dcerine-spolecnosti/cds/pro_zakazniky/konference2015/21_pmac_michek_en.pdf.

Mihaleva, Mariya. n.d. “Bulgaria: Great Expectations for Electricity Trading.” http://roadmap2014.schoenherr.eu/bulgaria-great-expectations-electricity-trading/.

Ministry of Energy. 2015. “Bulletin on the State and Development of the Energy Sector in the Republic of Bulgaria.” https://www.me.government.bg/files/useruploads/files/eoos/buleti_-energy-_2015-eng.pdf.

Ministry of Industry and Trade. 2014. “National Energy Efficiency Action Plan of the Czech Republic pursuant to Article 24(2) of Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on Energy Efficiency.” Government of the Czech Republic.

Ministry of Infrastructure. 2015. “National Energy Efficiency Action Plan 2014-2020 (An Ure 2020).”

Ministry of National Development. 2015. “The Hungarian National Energy Efficiency Plan until 2020.” Hungarian Government.

Nedelka, Martin, Christoph Lindinger, and Veronika Hocková. 2012. “Wholesale Electricity Trading In Czech Republic: A Basic Primer To Electricity And Gas Wholesale Trading.” *Energy and Natural Resources*. http://www.mondaq.com/x/199498/Oil+Gas+Electricity/Wholesale+Electricity+Trading+In+A+Basic+Primer+To+Electricity+And+Gas+Wholesale+Trading.

Peltoniemi, Matias. 2015. “Benefits of Regional Cooperation in the South East Europe Electricity Sector.” Espoo, Finland: Aalto University, School of Engineering. https://aaltodoc.aalto.fi/bitstream/handle/123456789/19046/master_Peltoniemi_Eero_2015.pdf?sequence=1.

Pototschnig, Alberto, Martin Godfried, Lord Mogg, and Bart Vereecke. 2015. “Presentation of the Key Findings from the 2014 Market Monitoring Report.” presented at the The 4th Annual Report on Monitoring the Electricity and Natural Gas Markets, Brussels, Belgium, November 30. http://www.ceer.eu/portal/page/portal/EER_HOME/EER_WORKSHOP/CEER-ERGEG%20EVENTS/CROSS-SECTORAL/ACER-CEER_MMR_2015/MMR%202015%20Presentation.pdf.

Regulatory Office for Network Industries Slovakia (URSO). 2015. “National Report for the Year 2014 Submitted as of 31 July 2015.” Bratislava, Slovakia.

Romanian Government. 2015. “Annex to Government Resolution No. 122/2015 for the Approval of the National Energy Efficiency Action Plan.” The Official Journal of Romania.

Smart Energy Demand Coalition (SEDC). 2015. “Mapping Demand Response in Europe Today 2015.” Brussels, Belgium: Smart Energy Demand Coalition (SEDC).

SeeNews. 2015. “Competition in Croatia’s Energy Market Limited.” *Power Market Review*. November 18. http://powermarket.seenews.com/news/competition-in-croatias-energy-market-limited-eu-502203.

———. 2016. “Croatia’s CROPEX to Launch Day-Ahead Market on Feb 10.” *Power Market Review*. January 22. http://powermarket.seenews.com/news/croatias-cropex-to-launch-day-ahead-market-on-feb-10-510079.

Slovenské elektrárne. 2014. “The Slovak Electricity Market.” http://www.seas.sk/company.

Sofia News Agency. 2016a. “Bulgaria’s Energy Exchange Starts Electricity Trade.” *Novinite.com*. January 19. http://www.novinite.com/articles/172703/Bulgaria’s+Energy+Exchange+Starts+Electricity+Trade.

———. 2016b. “Prices at Bulgaria’s New Energy Exchange ‘Unexpectedly Low.’” *Novinite.com*. January 21. http://www.novinite.com/articles/172744/Prices+at+Bulgaria%27s+New+Energy+Exchange+%27Unexpectedly+Low%27.

Stepan Krska. 2014. “Current Situation on the Czech Electricity Market: With an Emphasis on the Fourth Regulatory Period of the Czech Energy Regulatory Office.” Master’s Thesis, Prague, Czech Republic: Charles University in Prague, Faculty of Social Sciences, Institute of Economics.

Vasiliu, Delia, and Remus Ene. 2015. “Electricity Regulation in Romania: Overview.” *Practical Law*. September 1. http://uk.practicallaw.com/4-566-2907?source=relatedcontent#.

Zdanik, Josef. 2015. “Cost-Benefit studies(CBA) for Smart Metering Roll-out in the EU.” presented at the Smart grids in practice, Bratislava, Slovakia, September 29. www.pwc.com.

List of Acronyms

ACER	Agency for the Cooperation of Energy Regulators
AD	Active Demand
AEEG	Autorità per l'Energia Elettrica il Gas
AMI	Advanced Metering Infrastructure
AMR	Automatic Meter Reading
APG	Austrian Power Grid
APX	Power Spot Exchange
Belpex	Belgian Power Exchange
BMWi	Bundesministerium für Wirtschaft und Energie
BRP	Balance Responsible Party
BSP	Balancing Service Provider
C&I	Commercial and Industrial
CAISO	California Independent System Operator
CAPEX	Capital Expenditure
CBA	Cost-benefit analysis
CER	Commission for Energy Regulation
CHP	Combined Heat and Power
CIM	Continuous Intraday Market
CM	Capacity Market
DAM	Day Ahead Market
DECC	Department of Energy & Climate Change
DK1	Electricity Grid Price Area for West Denmark
DK2	Electricity Grid Price Area for East Denmark
DR	Demand Response
DSBR	Demand-Side Balancing Reserve
DSO	Distribution System Operator
DSU	Demand Side Unit
EDF	Électricité de France S.A.
EDRP	Emergency Demand Response Program
EED	Energy Efficiency Directive
EEX	European Energy Exchange
ELES	Elektro-Slovenija
ENEL	Ente nazionale per l'energia elettrica
ENTSO-E	European Network of Transmission System Operators for Electricity
EPEX	European Power Exchange
ERCOT	Electric Reliability Council of Texas
ERDF	Électricité Réseau Distribution France
ERO/ERU	Energy Regulatory Office of the Czech Republic
FCDM	Frequency Control by Demand Management
FCR	Frequency Containment Reserve
FCR-D	Frequency Controlled Disturbance Reserve
FCR-N	Frequency Containment Reserve - Normal
FERC	Federal Energy Regulatory Commission
FiT	Feed-in-Tariff
FRFS	Fast Reserve Firm Service
FRR	Frequency Restoration Reserve
FRR-A/FRRa	Frequency Restoration Reserve - Automatic
FRR-M/FRRm	Frequency Restoration Reserve - Manual
GW	Gigawatt

GWh	Gigawatt hour
HV Grid	High Voltage Grid
I-SEM	Integrated Single Electricity Market
ICE	Intercontinental Exchange, Inc.
ICH	Interruptible Contract Programme
ICT	Information and Communication Technologies
IGCC	International Control Cooperation
INC	Imbalance Netting Cooperation
ISO-NE	Independent System Operator New England
kW	Kilowatt
kWh	Kilowatt hour
M&V	Measurement and Verification
mHz	MiliHertz
MISO	Midcontinent Independent System Operator, Inc.
MR	Minute Reserve
MW	Megawatt
MWh	Megawatt hour
NEBEF	Notification d'Échange de Blocs d'effacement
NEEAP	National Energy Efficiency Action Plan
NRA	National Regulatory Authority
NYISO	New York Independent System Operator
Ofgem	Office of Gas and Electricity Markets
OMIE	OMI-Polo Español S.A
OPEX	Operating Expense
OTC	Over the Counter
OTE	Czech electricity and gas market operator
PAB	Pay-as-Bid
PAC	Pay-as-Cleared
PCR	Primary Control Reserve
PJM	Pennsylvania, Jersey, Maryland Market
PQ	Pre-qualification
PSE	Polskie Sieci Elektroenergetyczne
PXE	Power Exchange Central Europe
RES	Renewable Energy Sources
RPM	Regulating Power Market
RR	Replacement Reserve
RTE	Réseau de Transport d'Électricité
SBR	Supplemental Balancing Reserve
SCR	Secondary Control Reserve
SDR	Strategic Demand Reserve
SEM	Single Electricity Market
SGEM	Smart Grids and Energy Markets
SGR	Strategic Generation Reserve
SME	Small and Medium Enterprises
SR	Strategic Reserve
STOR	Short Term Operating Reserve
STOR TR	STOR Tender Round
TA	Transitional Arrangements
TOR	Technical and Organisational Rules
ToU	Time-of-Use
TSO	Transmission System Operator

TW	Terawatt
TWh	Terawatt hour
UMIG	Utility Market Implementation Guide
USEF	Universal Smart Energy Framework
VOLL	Value of Lost Load
VPP	Virtual Power Plant

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