DRIvE

Demand Response Integration tEchnologies:

Unlocking the demand response potential in the distribution grid

Project H2020 n° 774431

D2.2 Current regulatory framework regarding Demand Response

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Abstract

Increasing flexibility is key for the reliable operation of future power systems with very high penetration levels of Variable Renewable Energy Sources (VRES). In this scenario, the most significant source of flexibility is Demand Response (DR).

The DRIvE project intends to develop and validate a fully-integrated ICT infrastructure consisting of interoperable DR-enabling energy management solutions for residential and tertiary buildings and a platform for effective and secure management of flexibility at the level of the distribution grid.

Firstly this report focuses on the current regulatory European Union policies related to the electricity market prior to unlocking Demand Response, such as electricity market directive 2009/72 as well as internal market electricity regulation 2009/714 in order to analyse the situation of the existing energy market legislation. Additionally, climate change regulations are reviewed including energy efficiency directive 2012/27, renewable directive 2009/28 and other energy regulations.

Therefore, while the market outlined for Demand Response is progressing, it needs further regulatory improvements, so it is introduced a discussion on a recent bundle of energy market legislation proposals, still pending approval by the European Parliament, published in the Clean Energy for all Europeans package, also called the "Winter Package" with the aim to amend existing legislation. Those legislative proposals cover the design of the new electricity market, energy efficiency, renewable energy and security of supply and governance rules for the Energy Union. The Winter Package launched by the European Commission marks the start of the large-scale unlocking flexibility to enable Demand Response potential in Europe, most importantly for load side flexibility, also known as demand side response. It points out explicitly that aggregated load should be allowed and encouraged to participate, as well as participation initiatives of demand-side resources in electricity markets should be authorised, developing new different roles such as aggregators and "prosumers".

Finally, the report provides a general description of how blockchain-based currencies can help prosumers to trade energy or flexibility with other consumers through smart contracts in a peer-to-peer management system, for payment transactions to be transparent, secure, reliable and timely among participants. This includes a brief discussion of how Blockchain applications for currencies work and how it can support the design of flexibility energy management systems. It concludes with a review of policy agenda for digital currencies in the European Union.

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Abstract (for dissemination)	Increasing flexibility is key for the reliable operation of future power systems with very high penetration levels of Variable Renewable Energy Sources (VRES). In this scenario, the most significant source of flexibility is Demand Response (DR). The DRIvE project intends to develop and validate a fully-integrated ICT infrastructure consisting of interoperable DR-enabling energy management solutions for residential and tertiary buildings and a platform for effective and secure management of flexibility at the level of the distribution grid. Firstly, this report focuses on the current regulatory European Union policies related to the electricity market prior to unlocking Demand Response, such as electricity market directive 2009/72 as well as internal market electricity regulation 2009/714 in order to analyse the situation of the existing energy market legislation. Additionally, climate change regulations are reviewed including energy efficiency directive 2012/27, renewable directive 2009/28 and other energy regulations. Therefore, while the market outlined for Demand Response is progressing, it needs further regulatory improvements, so it is introduced a discussion on a recent bundle of energy market legislation proposals, still pending approval by the European Parliament, published in the Clean Energy for all Europeans package, also called the "Winter Package" with the aim to amend existing legislation. Those legislative proposals cover the design of the new electricity market, energy efficiency, renewable energy and security of supply and governance rules for the Energy Union. The Winter Package launched by the European Commission marks the start of the large-scale unlocking flexibility to enable Demand Response potential in Europe, most importantly for load side flexibility, also known as demand side response. It points out explicitly that aggregated load should be allowed and encouraged to participate, as well as participation initiatives of demand-side resources in electricity markets should be authorised, developing new different roles such as aggregators and "prosumers". Finally, the report provides a general description of how blockchain-based currencies can help prosumers to trade energy or flexibility with other consumers through smart contracts in a peer-to-peer management system, for payment transactions to be transparent, secure, reliable and timely among participants. This includes a brief discussion of how Blockchain applications for currencies work and how it can support the design of flexibility energy management systems. It concludes with a review of policy agenda for digital currencies in the European Union.

Keywords	Demand Response, unlocking, aggregators, Winter-Package, legislative framework, Electricity Directive, Electricity Regulation Directive, Energy Efficiency Directive, Union's electricity market, low carbon economy, clean energy economy, flexibility, economic signals.

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List of abbreviations and acronyms

ACER	Agency for the Cooperation of Energy Regulators
BRP	Balance Responsible Party
CER	Commission for Energy Regulation
CREG	Commission for Electricity and Gas Regulation
DR	Demand Response
DNO	Distribution Network Operators
DSM	Demand Side Management
DSO	Distribution System Operator
EC	European Commission
ED	Energy Directive
EED	Energy Efficiency Directive
ENTSO	European Network of Transmission System Operators
ENTSO-E	European Network of Transmission System Operators for Electricity
EPBD	Energy Performance Building Directive
ICT	Information and Communication Technologies
IEA	International Energy Agency
MDI	Market Design Initiative
NRA	National Regulatory Authority
PV	Photovoltaic
RED	Renewable Directive
RES	Renewable Energy Sources
RES-E	Renewable Energy Sources providing electricity
SEM	Single Electricity Market
SGEM	Smart Grids and Energy Markets
SNL	Quickly Interruptible Loads
ToU	Time -of -Use
TSO	Transmission System Operator
USEF	Universal Smart Energy Framework
VPP	Virtual Power Plant
VRE	Variable Renewable Electricity
VRES	Variable Renewable Energy Sources

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1 INTRODUCTION

1.1 REGULATION. OVERALL CONTEXT

The Paris Agreement urges that the increase of the average global surface temperature is limited to 1,5 – 2 °C above pre-industrial levels to steer clear of the worst impacts of climate change [1]. Keeping the temperature increase value less than 2 °C requires the application of cost-effective strategies such as the decarbonisation of the energy sector. CO_2 emissions from energy sector represent over three quarters of the anthropogenic GHG emissions, and about 60% of global emissions energy-related in 2013 [2].

The EU Commission has compromised on an ambitious plan for the European Union's electricity market [3]. It will be a major instrument in conducting the transition to a low carbon economy by 2050, the average on the carbon intensity of the EU's economy will be 43% lower in 2030 than nowadays [4]. That means EU citizens or industrial users should gradually switch to electricity as energy source, not only as a source of lighting, heating and cooling, but also transportation. Electricity should in turn be produced or generated from low carbon sources such as solar photovoltaic (PV), wind, hydro energy and sustainable biofuels, biomass or biogases.

On 30 November 2016, the European Commission presented the Clean Energy for all Europeans package, also called the "Winter Package" [3], as the EU's major vector legislative package measures with the ambition of providing the stable legislative framework needed to boost up to a clean energy economy successful transition. To be successful, the Winter Package points out explicitly that aggregated loads and demand-side resources should be allowed and encouraged to participate in electricity markets. This supposes an important change in the organization and also on the regulation of the EU electricity market, since a decentralized market has more players and creates new different roles such as aggregators and "prosumers", leading to a number of novel legal issues and challenges. By facing these challenges, the Winter Package takes an important step on paving the way to the creation of the Energy Union. It includes eight proposals that can be grouped into three comprehensive categories: proposals amending existing energy market regulations, proposals amending existing climate change legislation, and lastly, but not less important, proposals for a new regulation on risk and governance regulation of the Energy Union.

Renewable Energy Sources for electricity (RES-E), which has high levels of intermittent energy flows (e.g. solar and wind), plays an essential role in replacing fossil fuels in electricity production [5]. In accordance with the 2 °C scenario of the International Energy Agency (IEA), Member States are required by the current Renewable Energy Directive (RED) [6] to enhance the share of renewable energy sources (RES) by 2020 to 20%. Notwithstanding, the European Council set a new target of at least 27% for the share of renewable energy consumed in the EU in 2030 [3]. The contribution of RES-E in European Union Member States regarding to electricity supply has to increase from 11% in 2014 to minimum of this 27% by 2030, together with more decentralised production and self-consumption [7] [8].

As a fundamental rule, electricity supply and demand must be balanced at all times. Traditionally, this has been achieved by adjusting electricity supply to match demand that varies at different times of the day. However, this raises a problem as the share of power generation from variable renewables such as wind and solar photovoltaic increase. Thereby, the further the integration of variable renewable energy sources in electricity markets, the more crucial is the need for flexibility. Variable Renewable Electricity (VRE) sources are characterized by their variability, uncertainty and location dependence, and should interact with the non-VRE sources of the electrical system, demanding new managerial challenges, associated with grid operation and the need for flexibility resources (e.g. demand response, storage). This results in major technological, economic and legal challenges for the EU institutions and the Member States.

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The Winter Package launched by the European Commission marks the start of the large-scale unlocking of Demand Response (DR) potential in Europe, most importantly for load flexibility. Also known as demand side response, DR refers in general to the ability of the demand side to be flexible, responsive and adaptive to economic signals. Proposed text includes amending the Electricity Directive (ED) [9] and introducing new regulation on the internal electricity market [10], unlocking flexibility and enabling Demand-Side Response as a resource for all organized electricity markets. This could represent the most important regulatory context change ever seen for Demand Response.

The importance and necessity of DR is acknowledged by the European Commission. Adequate price signals would reflect the actual costs of various electricity supply activities. In response to prices, demand-load adjustment would have a positive impact on society by stimulating efficient electricity system operations and markets [11]. DR empowers residential, commercial, as well as industrial consumers by providing control signals or economic incentives to control their use of demand side assets at strategic times. These demand side assets could involve their consumption, use of distributed generation, EV charging or storage capabilities. The Energy Efficiency Directive (EED), Art.15 [12], clearly urges European National Regulatory Authorities (NRA) to promote demand-side resources, such as DR, in participating along with supply in wholesale and retail markets and providing balancing and ancillary services to network operators in a non-discriminatory manner. DR potential in the EU electricity markets is believed to be high but currently underutilized, especially for residential customers.

1.2 THE DRIVE PROJECT

DRIvE is a research and innovation action funded by the European Commission from the European Union's Horizon 2020 research and innovation program under Grant Agreement n°774431. Energy prices affect the competitiveness of the whole economy and particularly represent on average 6.2% of annual household expenditure [13]. DRIvE Project aims at unlocking flexibility to enable DR potential of residential and tertiary buildings in the distribution grid through a full-fledged platform bridging seamlessly the value-chain from planning and design of assets/buildings towards optimal operations in the next generation smart grids, paving the way to a fully deployed DR market services in the distribution network.

To focus efforts, a set of objectives have been established, namely:

1. Enable DR potential in residential and tertiary buildings through universally interoperable solutions which integrate innovative forecasting and optimisation algorithms.
2. Optimise distribution grid flexibility through a multi-agent based DR ICT platform for aggregators which adopt last advances in distributed control and artificial intelligence.
3. Develop cyber-security services for smart grids.
4. Develop innovative business models for participation in DR schemes in the distribution grid.
5. Create a customer portal engaging end-users in DR schemes.
6. Demonstration of the project in multiple pilots involving real district data and grid stakeholders.

1.3 THE PRESENT DOCUMENT

This document intends to analyse the current regulatory framework for Demand Response services. Current European Union Policies aim to support the development and promotion of DR initiatives, so a thorough review of the recently released Winter Package is undertaken to provide an overview of how the future regulatory environment at European level might evolve and how this will impact the DRIvE implementation of requirements for the solution to be developed during the project.

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Chapter 2 covers current regulatory framework for Demand Response in EU directives. That is existing "energy market" legislation directives and policies, such as, Electricity Directive (ED) of the third energy package, concerning common rules for the Internal Electricity Market 2009/72/EC [9]; this chapter also covers a review of existing "climate change" legislation directives, i.e. Renewable Directive 2009/28/EC [6] and Energy Efficiency Directive 2012/27/EU [12]; likewise, Energy Performance Building Directive 2010/31/EU [14].

Chapter 3 overviews the collection of proposals included in Winter Package [3], grouped into three categories: (i) new proposals amending existing "energy market" legislation, called the Market Design Initiative; (ii) proposals to integrate new "climate change" goals; and, (iii) proposals for the new measures included in Winter Package, such as Risk and Governance regulation.

Chapter 4 outlines the status quo of the regulatory framework structures for DR across some member states markets.

Chapter 5 reviews the requirements and policy agenda for digital currencies and blockchain technology in the European Union to support design of flexibility management components, and specifically how can Blockchain helps prosumers to trade flexibility directly with other consumers in a peer-to-peer network.

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2 CURRENT REGULATORY FRAMEWORK FOR DR IN EU DIRECTIVES

2.1 EU LEGISLATION ON DEMAND RESPONSE

The current European regulatory framework on demand response is heterogeneous among its members States because the EU gives them the freedom to design their markets and regulatory frameworks to suit national conditions. A simple explanation for the difficulty of having a common working regulatory EU framework on DR is the non-existence of a single European energy market. Although in the EU for the moment there isn't any harmonized DR framework, there are several EU directives which address DR issues. This is reflected in several important official documents texts:

- "An Energy Policy for Europe", 2007 (COM(2007) 1 final) [15].
- The EU Treaty of Lisbon 2007 ('Treaty on the Functioning of the European Union) [16].
- "Energy Efficiency Directive" 2012/27/EU [12].
- "Electricity Directive" 2009/72/EC [9].

The Electricity Directive 2009 of the Third Energy Package defines the concept of "energy efficiency/demand-side management", acknowledging the positive impact on environment, security of supply, of reducing primary energy consumption and peak loads. Art. 25.7 requires network operators to consider Demand Response and energy efficiency measures when planning system upgrades. Art. 3.2 also considers the implementation of long-term planning, and the access of third parties to the system. This language was strengthened further within the Energy Efficiency Directive (EED) [12].

The Energy Efficiency Directive 2012 constitutes a significant step towards the development of Demand Response in Europe. In particular:

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, 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". [12]

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

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> […] 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." [12]

Article 15.8 therefore requires that regulators, TSOs and DSOs, adjust the technical modalities and requirements for market participation in line with participant's 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:

- Authorise Demand Response, allowing consumer load to compete alongside generation assets in all markets;
- Legalise and enable aggregation in all markets;
- Adjust technical modalities in all markets, in line with consumer capabilities and market requirements. [12]

The proposals for a new Directive and for a new Regulation on the internal market for electricity, add new provisions on explicit demand response [17] [18]:

- Definition of an aggregator: 'Aggregator' is defined as a market participant who combines multiple customer loads or supplied electricity for sale, purchase or auction in any organised energy market. 'Independent aggregator' is an aggregator that is not affiliated to a supplier or to any other market participant;
- Member States should define frameworks for independent aggregators and for demand response along principles that enable their full participation in the market;
- Products should be defined on all organised energy markets, including ancillary services and capacity markets to encourage the participation of demand response;
- Contract with an aggregator: final customers do not require consent from their supplier to conclude a contract with an aggregator, their contract can be terminated within three weeks without termination fee that exceeds direct economic loss to the aggregator;
- Members States have to ensure that aggregators can take part in the retail market without needed the consent of other market participants. Member States also must set rules and procedures for the data exchange between market participants;
- Member States shall ensure that final customers are entitled to receive all relevant demand response data or data on supplied and sold electricity at least once per year.

2.2 EU LEGISLATION ON ENERGY EFFICIENCY

According to the European Commission, buildings are responsible for 40% of energy consumption and 36% of CO_2 emissions in the EU. Currently, 35% of buildings are over 50 years old in the EU. By improving the energy efficiency of buildings, the total EU energy consumption could be reduced by 5-6% and CO_2 emissions by 5%. [19]

The Energy Performance of Buildings Directive (EPBD) adopted in 2010, defined as a systematic, clear and comprehensive package for professionals, member states and third countries, comprises a set of binding measures to help the EU to reach 20% energy efficiency by 2020. It mandates that: [14]

1) Energy distributors or retail energy sales companies have to achieve 1.5% energy savings per year through the implementation of energy efficiency measures;
2) The public sector in EU countries should purchase energy efficient buildings, products and services;

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3) Every year, governments in EU countries must carry out energy efficiency renovations on at least 3% (by floor area) of the buildings they own and occupy;
4) National incentives be in place for SMEs to undergo energy audits;
5) Large companies will make audits of their energy consumption to help them identify ways to reduce it;
6) Member States must establish inspection schemes for heating and air conditioning systems;
7) The energy performance of buildings should be calculated based on a methodology, which may be differentiated at national and regional level;
8) Energy performance certificates must be included in all advertisements of sales or rental of buildings;
9) It is the sole responsibility of the Member States to set minimum requirements for the energy performance of buildings and building elements;
10) All new buildings must be nearly zero energy buildings by the end of 2020.

In November 2016, the European Commission presented the Clean Energy package [3]. The EU has committed to reduce CO_2 emissions by 40% by 2030. To do this, the proposal of the new EPBD [20] aims at putting energy efficiency first, achieving global leadership in renewable energies and providing a fair deal to the consumers.

Furthermore, the new EPDB draft proposes:

- Introduction of more effective provisions on regular inspections of heating and air-conditioning systems, building automation and control;
- Ecodesign Working Plan for 2016-2019: includes a list of new product groups with largest saving potentials, such as building automation and control systems, for which the European Commission will be launching dedicated studies at the end of 2018 [21]. It provides EU-wide rules for improving the environmental performance of products, such as household appliances and ICT. It has set out a minimum mandatory requirement for the energy efficiency of these products, such as air conditioners and comfort fans [22].
- The Energy Labelling Regulation complements this Ecodesign Working Plan by establishing mandatory labelling requirements and helping consumers choose products with high environmental performances [22].
- A Smart Finance for Smart Buildings Initiative [23] was also presented together with the revised EPBD, which stimulates public and private investments for energy efficiency in buildings.

Another important EU directive is the Energy Efficiency Directive (EED) of 2012 [12]. The EED sets a requirement for the Member States to achieve at least 20% improvements in energy efficiency by 2020. Some specific measures and politics are:

- The public sector in the EU countries should purchase energy efficient buildings, services and products;
- Energy consumers should be empowered to better manage their consumption, including free and easy access to data on consumption through individual metering;
- National incentives for Small and Medium-sized Enterprises (SMEs) should undergo energy audits;
- Large companies will make audits of their energy consumption every 4 years to help them identify ways to reduce it;
- These energy audits should consider relevant European International standards, such as EN ISO 50001, EN 16247-1;
- Minimum energy efficiency standards for a variety of products, such as boilers, household appliances & lighting;
- Mandatory energy efficiency certificates accompanying sale and rental of buildings;

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- An annual reduction of 1.5% in national energy sales.

The proposal for the update of the EED**,** which is also a part of the CEP includes a new 30% energy efficiency target for 2030. In addition [21]:

- Member states can consider a certain amount the renewable energy generated in/on their managed buildings to satisfy energy savings requirements;
- The commitment period beyond 2020 for long term energy efficiency measures, such as the renovation of buildings, is extended to 2030.

2.3 EU LEGISLATION ON DATA PRIVACY AND SECURITY

The General Data Protection Regulation (GDPR) [24] was approved in April 2016 and is to be enforced by 25th of May 2018.

Personal data needs to be processed lawfully, fairly and in a transparent manner without being further processed in a manner that is incompatible with the specified, explicit and legitimate purpose. Under the GDPR, companies may not legally process anyone's personally identifiable information without meeting at least one of the following six conditions (article 6 GDPR):

1) Explicit consent of the data subject;
2) Processing is necessary for the performance of a contract with the data subject or to take steps to enter into a contract;
3) Processing is necessary for compliance with a legal obligation;
4) Processing is necessary to protect the vital interests of a data subject or another person;
5) Processing is necessary for the performance of a task carried out in the public interest or in the exercise of official authority vested in the controller;
6) Processing is necessary for the purposes of legitimate interests pursued by the controller or a third party, except where such interests are overridden by the interests, rights or freedoms of the data subject.

Companies located both in the EU and outside the EU that use data from EU citizens must comply with these conditions. Companies that conduct data or monitor data subjects on a large scale must appoint a Data Protection Officer (DPO), who governs the data and ensures that the company complies with the GRDP.

The data subject has the 'right to be forgotten' (i.e. erased from company's storage), right of access to the data (that a company has stored about them), right to object (refuse permission, company can ignore refusal in case it can satisfy one of the legal conditions for processing the subject's personal data but must notify and explain it to the subject), right to rectification in case of inaccurate data and the right of portability (access of personal data and transfer it).

Each country must have a national Data Protection Authority (DPA), who is tasked with protecting information privacy.

Another EU Directive which was adopted by the Parliament in 2016, is the Directive of Security of Network and Information Systems (NIS) 2016/1148 [25]. This NIS directive aims to achieve a high common level of network and information systems security across the EU in 3 ways:

1) Improve cyber security capabilities at national level by establishing a Computer Security Incident Response Team (CSIRT) and competent national NIS authority;
2) Increase cooperation on cyber security among EU member states (cooperation group to facilitate strategic cooperation and exchange of information);

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3) Introduce security measures and incident reporting obligations for Operators of Essential Services (OESs) in Critical National Infrastructure (CNI) and Digital Service Providers (DSPs).

The NIS directive applies to OESs that are established in the EU and DSPs that offer services to persons in the EU. They do not apply to hardware or software that are considered small or micro business (<50 people employed and/or balance sheet <10 million €).

The NIS directive requires OESs and DSPs to:

1) Take appropriate technical and organisational action to secure their network and information systems;
2) Consider the latest developments and the potential risks facing the system;
3) Take appropriate measures to prevent and minimise the impact of security incidents to ensure service continuity;
4) Notify the relevant supervisory authority of any security incident having a significant impact on service continuity without undue delay.

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3 WINTER-PACKAGE OVERVIEW

On 30 November 2006 the European Commission published the "Clean Energy for all Europeans" package [3], also known as the "Winter Package", with the aim of leading the clean energy transition and achieving a new goal of reducing CO_2 emissions by at least 40% and improving energy efficiency by at least 30% in the EU as a whole by 2030.

Since 1996, this is the 4th package of measures that the European Commission approved to improve and empower the energy situation of Europe. The Winter Package (Figure 1) includes both legislative proposals as well as non-legislative initiatives focused on reforming the European Union's electricity market to facilitate the transition to a clean energy economy and reach three main goals:

- putting energy efficiency first;
- achieving global leadership in renewable energy;
- providing a fair deal for consumers.

That means that it covers not only measures related to improving energy efficiency and increasing the use of renewables, but also proposals to reorganize the electricity market and fight against the energy poverty, as shown in Table 1.

The Winter Package aims to adapt the framework shown in Figure 1 to the reality of the current market.

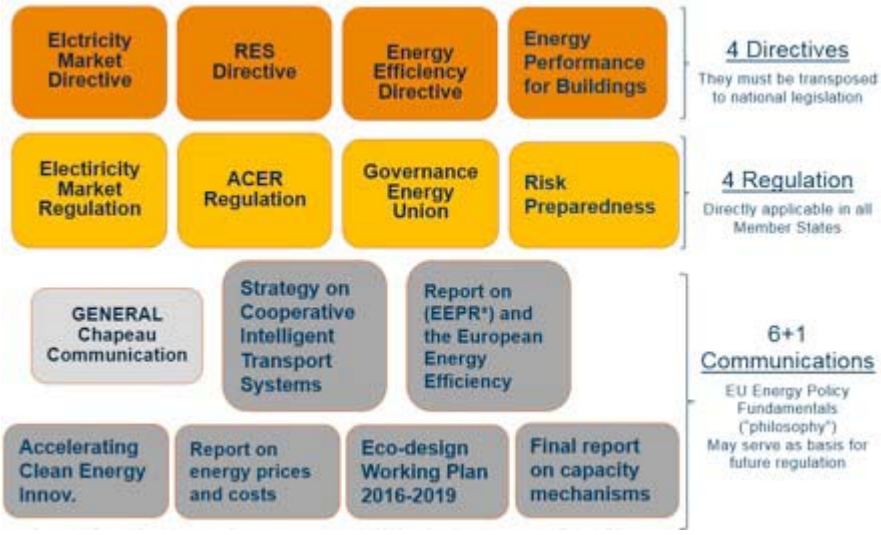

Figure 1. Winter Package Framework

To do so it includes 8 legislative proposals: 4 directives and 4 regulations. They are as follows:

- Proposal for a recast of Internal Electricity Market Directive (E-Directive) [17].
- Proposal for a recast of Internal Electricity Market Regulation (E-Regulation) [18].
- Proposal for a recast of AC Regulation [26].
- Proposal for a Regulation on Risk-Preparedness in the Electricity Sector [27].
- Proposal for a recast of Renewable Energy Directive [28].
- Proposal for a revised of Energy Efficiency Directive [21].
- Proposal for a revised of Energy Performance Buildings Directive [20].
- Proposal for a Regulation on the Governance of the Energy Union [29].

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	Consumer	Supply energy companies	Market	Promotes
Proposal for a recast of Internal Electricity Market Directive. **Proposal for a recast of Internal Electricity Market Regulation.** **Proposal for a recast of ACER Regulation.**	• Simplify day by day operations • Active consumer • Access and use of energy data • Certified energy comparison tool – price control • Electricity generator • Active demand response actor • Figure of aggregator	• Provide smart meters • Dynamic electricity price contracts • Self-consumption	• More flexibility management • New EU Distribution System Operator (DSO) entity • More coordination between Transmission System Operators (TSO) and Regional Operational Centers (ROCs) • ROCs gain more relevance	• Active consumer • Prosumer and aggregator • Flexibility management of the system • Operators' coordination
Proposal for a Regulation on Risk-Preparedness in the Electricity Sector and Repealing the Security of Supply Directive				• EU global market coordination and exchange of information
Proposal for a recast of Renewable Energy Directive.	• Increment in-situ EERR generation, storage and self-consumption	• Increment EERR generation and storage	• Increment to at least 27% renewables in final EU energy consumption by 2030	• Long-term stability for investors
Proposal for a revised of Energy Efficiency Directive.	• Member States will impose specific energy saving requirements to the obligated parties designated	• Implementation and use of smart metering • Billing information	• Energy efficiency of 30% by 2030 in the EU as a whole • No binding national targets for the Member States	• Primary goal of the Winter Package
Proposal for a revised of Energy Performance Buildings Directive.	• Demand response actors	• Self-consumption to be part of the annual obligation of 1.5% of the energy savings of the energy suppliers		• Energy efficiency certificates, inspection, monitoring and control of the use of energy • Buildings sensitive to price signals

Table 1. Key features of the New Regulations Summary

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3.1 MDI. MARKET DESIGN INITIATIVE

The current electricity market design is based on the rules of the Third Energy Package (in particular the Electricity Directive [9] adopted in 2009). It is complemented by legislation against market abuses[1] and implements legislation concerning electricity trade and grid operation rules[2].

It has strengthened the consumer's position in energy markets by basing the market on concepts like the right of access for third parties to the electricity grid, free choice of suppliers for consumers, the removal of barriers to cross-border trade and market supervision by independent energy regulators. It also supports EU-wide cooperation of regulators and grid operators within the Agency for the Cooperation of Energy Regulators (ACER) and the European Network of Transmission System Operators (ENTSO).

The Market Design Initiative promoted in the Winter Package aims to adapt these current market rules to the reality and needs of the actual market, considering its dynamic change and available technologies.

One of the main goals of the new market is that the consumers become more active and central figures. To do this, it promotes greater transparency in the market and focuses on better involving all consumers in the energy system through new legislation and price signals. Another key goal is to improve the consumers' situation by creating tools that simplify the supply choice, by facilitating access to reliable energy price comparisons and by providing the opportunity to produce and sell their own electricity.

Finally, the Winter Package also contains some measures to prevent energy poverty by protecting the more vulnerable consumers.

3.1.1 New Energy Market Legislation

The Market Design Initiative (MDI) includes:

- A new directive (E-Directive) [17] (Internal Electricity Market) amending and repealing Directive 2009/72 [9]
- A new regulation (E-Regulation) on the internal electricity market [18], amending and repealing Regulation 714/2009 [10]
- A new regulation [26] repealing Regulation 713/2009 [30] on the ACER (ACER Regulation)

The new rules will include:

[1] Regulation (EU) No 1227/2001 of the European Parliament and of the Council of 25 October 2011 on wholesale energy market integrity and transparency OJ L 326, 8.12.2011, p.1-16; Commission Implementing Regulation (EU) No 1348/2014 of 17 December 2014 on data reporting implementing Article 8(2) and Article 8(6) of Regulation (EU) No 1227/2011 of the European Parliament and of the Council OJ L 363, 18.12.2014, p-121-142

[2] Commission Regulation (EU) 2015/1222 of 24 July 2015 establishing a guideline on capacity allocation and congestion management OJ L 197, 25.7.2015, p. 24–72; Commission Regulation (EU) 2016/631 of 14 April 2016 establishing a network code on requirements for grid connection of generators OJ L 112, 27.4.2016, p. 1–68; Commission Regulation (EU) 2016/1388 of 17 August 2016 establishing a Network Code on Demand Connection OJ L 223, 18.8.2016, p. 10–54; Commission Regulation (EU) 2016/1447 of 26 August 2016 establishing a network code on requirements for grid connection of high voltage direct current systems and direct current-connected power park modules OJ L 241, 8.9.2016, p. 1–65; Commission Regulation (EU) 2016/1719 of 26 September 2016 establishing a guideline on forward capacity allocation OJ L 259, 27.9.2016, p. 42–68; other Guidelines and network codes have been endorsed Member States' approval and are awaiting adoption.

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Consumer	Easier everyday operations, like billing, by the improvement of digital customer information.
	Access to more reliable information using the certified online price comparison tools. All EU electricity consumers will get free-of-charge access to at least one certified energy comparison tool.
	Reduction of costs to switch suppliers according to the restriction on the use of switching fees by the energy supply companies. These must be limited in size and contracts containing them must provide consumers with tangible advantages in return.
Energy price	Consumers will be able to request a smart meter from their energy supplier in order to benefit from market-based energy prices, giving the opportunity to decide when they will consume according to the energy price on each moment.
	Removal of retail price regulation while ensuring the full and appropriate protection of vulnerable consumers.
Electricity generation-Prosumer	Consumers and communities of consumers will be entitled to actively participate on the electricity market and generate their own electricity to consume it, store it or sell it back to the market. Therefore, shared self-consumption is allowed.
	Production limitations will be based on market mechanisms. The limitation of production may not affect more than 5% of the renewable power and cogeneration installed in the system
Demand Response	Every consumer will be able to offer demand-response and to receive remuneration, directly or through aggregators. Dynamic electricity price contracts reflecting the changing prices on the spot or day-ahead markets will allow consumers to respond to price signals and actively manage their consumption.
Grid management	A new EU Distribution System Operator (DSO) entity will be created. It will be responsible for putting in place rules on grid management and use and EU-level cooperation with Transmission System Operators (TSO). It will also work on the integration of renewables, distributed generation, energy storage, demand response and smart metering systems.
	The electricity system operation by TSOs will see more coordination on a regional level to ensure most optimal utilization of the grid and better grid stability. E-Regulation states that the Regional Operational Centers (ROCs) shall complement the role of TSOs by performing “functions of regional relevance”. ROCs are to be equipped with all relevant resources, including financial resources for fulfilling their obligations and carrying out their functions (Article 42)

Table 2: Market Design Initiative. New Rules included.

3.1.2 Enable Market Access for Demand Response

The existing market rules are based on the schema of a centralized generation with large-scale fossil fuel-based power plants and little participation of the consumers in energy production. The new market is more focused on decentralizing generation and promoting more alternative energy sources.

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The active role of consumers in this new market will allow consumers to offer DR and to receive remuneration for it, directly or through aggregators. There will be three main tools for them:

- Improved technologies, such as smart meters, that will allow them to manage their own energy consumption and offer demand response.
- Dynamic electricity price contracts reflecting the changing prices on the spot or day-ahead markets, which will allow consumers to respond to price signals and actively manage their energy costs.
- Legal capacity for generating their own electricity, consuming it directly or storing it for when it is needed.

The MDI also defines the role of the aggregator, who can pool the flexible demand and consumption of multiple actors. The new rules facilitate the framework for aggregators to operate on the electricity market. In some countries it is figure that already exists, but in most of the countries this will be a new agent on the market.

Article 17(3) of the E-Directive [17] requires that Member States shall encourage the participation of aggregators in the market and that the aggregator can enter the market without consent from other market participants. However, there must be transparent rules to assign roles and responsibilities to all market participants, including rules and procedures for data exchange between market participants, and which mechanism will apply to a conflict resolution.

3.1.3 Flexibility Management

The Winter Package promotes a transition to a market with an increased participation of the renewable energies to allow a low-carbon electricity production. That involves new challenges to secure and develop a cost-effective operation of Europe's power grids and electricity markets.

The overall electricity supply and demand needs to be in balance in physical terms considering each moment's situation. This balance is a precondition for the secure operation and stability of the electricity grid, thus avoiding the risk of black-outs. However, variable renewables could cover a very large part of electricity demand during one period (by 2030 it could be over 30%) and in the next period only cover a minor part of total consumption. Therefore, a decentralized market requires more flexible and efficient management, allowing market participation at short notice before actual delivery.

Current market arrangements do not promote or incentivize all market participants to adjust production and consumption plans on short notice and do not fully take into account possible contribution of cross-border resources, but this flexibility is essential to deal effectively with an increased share of variable renewable generation.

According to the recast E-directive[3] [17], the Commission proposes that DSOs shall cooperate through an EU DSO entity. The tasks of this entity are listed in Article 51 of the E-Regulation [18]. All DSOs meeting these conditions will be able to apply for membership. This entity, in cooperation with ACER, will draw a set of rules of procedures which can be both effective and representative of its potentially highly diverse membership.

[3] Article 35, E-Directive. The text is identical to the previous Article 26 of the Directive

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Chapter IV of the recast E-Directive clarifies the tasks of DSOs in relation to the procurement of network services to ensure flexibility[4], the integration of electrical vehicles recharging points[5], data management[6] and storage[7].

In parallel, the Commission Regulation has established a Guideline on Electricity Balancing ('Balancing Guideline') to harmonize certain aspects of the EU's balancing markets and to optimize cross-border usage. Indeed, efficient, integrated balancing markets are an important building block for the consistent functioning and flexibility of the market which in turn is needed for a cost effective integration of RES-E into the electricity market.

Storage[8] will be one of the technologies that will enable the grid to be more flexible, as it can balance peaks and drops in demand and supply. It will help to solve the uncertain long term generation of renewables energies and improve the feasibility of projects. The proposal initiative has proposed to give due credits to adjust its price as active solution thanks to its flexibility.

Article 36 of the E-Directive provides that as general rule DSOs shall not be allowed to own, develop, manage or operate energy storage facilities unless

- Following an open tender procedure, no other party has expressed an interest in entering this market.
- Storage facilities are necessary for the DSOs to fulfil their regulated tasks for the reliable and secure operation of the distribution system[9].

Both the electric vehicle recharging networks and storage operations have to be operated by legally unbundled entities, as required under Article 33, and these entities must maintain separate accounts, as required by Article 56 of the E-Directive.

3.1.4 Benefits of Aggregation

The legislative proposal allows the shared self-consumption and, therefore, promotes the figure of aggregator as the one that coordinates and manages the demand of the consumers and offers services of management of the demand to the system.

The aggregator functions include:

- responsibility for maximizing production with different and distributed sources in the supply area of the grid (residential, commercial buildings...), cooperating with prosumers and facilitating the exchange of energy between consumers (balance between surplus and needs of energy).
- incorporating storage systems distributed in buildings and in each transformer station to model the energy load curve that negotiates with the network operator (upstream of the transformation centre).
- having the competence to develop, install and operate a network of charging points for electric vehicles, either in the public space or in private parking lots.

[4] Article 32, E- Directive
[5] Article 33, E-Directive
[6] Article 34, E- Directive
[7] Article 36, E- Directive
[8] Article 2(48) and 54, E-Directive
[9] Article 54 – E-Directive applies a similar approach to TSOs

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Therefore, the aggregator benefits are:

- providing security and predictability to the system because it assumes the deviations in the technical and economic fields;
- combining the interests of all the consumers and represents them, not only in front of the distributor, but also in front of the operator of the system;
- managing the flow of energy according to needs, so it becomes a key element in the management of demand;
- a possible technological capability of, in certain situations, working in isolated mode and becoming a manager of a micro-network that maintains continuity in the supply. This mode of operation would allow the last step in supply quality, reducing almost to zero the total non-programmable supply chutes.
- assuming the financial and technical risk of operating the micro-network, both in front the system operator and consumers.

Article 17 of the E-Directive requires National Regulatory Authorities (NRAs) to encourage final consumers, including those offering demand response[10] though aggregators[11] and "active consumers"[12], to participate alongside generators in a non-discriminatory manner. It also sets the minimum conditions which Member States must adopt into national regulatory frameworks to encourage the participation of aggregators in retail markets.

Article 13 of the E-Directive gives final customers the right to contract with an aggregator directly, and without the prior consent of the energy supplier.

3.2 CLIMATE CHANGE GOALS ALIGNED WITH NEW MARKET

In order to achieve the new goal of reducing CO_2 emissions by at least 40% in 2030, the Winter Package includes legislative proposals on:

- Proposal for a recast of Renewable Energy Directive [28].
- Proposal for a revised of Energy Efficiency Directive [21].
- Proposal for a revised of Energy Performance Buildings Directive [20].

The proposal recast of the current Renewable Energy Directive [6] is strongly linked with other energy and climate legislative proposals, including the renewable energy package that includes measures to achieve the EU objective of reaching a level of at least 27% renewables in final EU energy consumption by 2030. (Article 5(2) of the revised RED [28]).

The renewable energy directive has synergies with the present initiative, basically with the importance of adapting the current market design to the increasing share of variable decentralized generation and technological development as well as to create a stable framework for investments in renewables.

Article 3, of chapter 2, sets the obligations for Member States to define a national integrated energy and climate plan for the period 2021 to 2030 by 1 January 2019, and for subsequent ten years periods.

The revision of the Renewable Energy Directive will include the basis to support schemes for market-oriented, profitable and more regionalized support to RES-E until 2030. The market design initiative

[10] As defined in Article 2(16) E-Directive
[11] As defined in Article 2(14) E-Directive
[12] As defined in Article 2(6) and further elaborated on inn Article 15 E-Directive

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also includes measures aimed at the integration of RES-E into the market, such as the priority shipping and access provisions previously contained in the Renewable Energy Directive.

The renewable segment of the Winter Package also deals with legal and administrative barriers to self-consumption. The aim is to simplify the administrative processes and centralize project procedures.

Article 15(9): requires Member States to remove administrative barriers to incorporating long-term power purchase agreements (PPAs) to finance renewables and facilitate their uptake.

To promote long-term stability for investors, it includes the anti-retroactivity clause specifying that the EU countries will ensure that the level and conditions of support granted to renewable energy projects cannot be reviewed retroactively.

Article 6: "Without prejudice to adaptations necessary to comply with State and rules, Member States shall ensure that the level of, and conditions attached to, the support granted to renewable energy projects are not revised in a way that negatively impacts the rights conferred there under and the economics of supported projects".

The recast of current Energy Efficient Directive [12] also interact with the present initiative as they affect the level and structure of electricity demand. The provisions previously contained in the energy efficiency legislation on demand response, billing and metering will be set out in the present initiative.

The revised directive [21] defines a goal of energy efficiency of 30% by 2030 in the EU as a whole. There are no binding national targets for the Member States, but there are "indicative targets" expressed as absolute levels of primary and final energy consumption in 2020 that will have to be modified by the Commission, as well as the planned contributions to achieve the objectives of the Union for 2030. Member States will impose specific energy saving requirements to the obligated parties designated on the basis of objective and non-discriminatory criteria for transport fuels and retailers.

The revised Directive [21] modifies the existing articles that are directly related to the achievement of the 2030 objectives and presents some new articles on consumer rights, such as an improvement in access to the tools related to smart digital meters, billing and the information on the consumption.

Billing and information on consumption must be accurate and real; consumers will receive it at no cost and will have access to their consumption data in an appropriate manner. Including the consumers of district heating and cooling consumers, who must get benefit from competitive prices based on their real energy consumption.

The recast of Energy Performance Buildings Directive [14] will allow self-consumption to be part of the annual obligation of 1.5% of the energy savings of the energy suppliers. It includes renewal objectives, energy efficiency certificates, inspection, monitoring and control of the use of energy.

It also includes obligations to provide one out of ten new or substantially renovated non-residential buildings with a point of charge for electric vehicles that is sensitive to price signals.

3.3 PROPOSALS FOR NEW MEASURES

The Winter Package also includes legislative proposals for new measures on Risk-Preparedness and Governance:

- Proposal for a Regulation on Risk-Preparedness in the Electricity Sector and Repealing the Security of Supply Directive [27].
- Proposal for a Regulation on the Governance of the Energy Union [29].

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The aim of the regulation on Risk-Preparedness proposal is to ensure that all Member States develop and use appropriate tools to prevent, prepare for and manage electricity crisis situations. The legal basis for the Regulation is therefore Article 194 of the Treaty on the Functioning of the European Union (TFEU). This article recognises that a degree of coordination, transparency and cooperation in Member States' policy making on security of supply is necessary to ensure the functioning of the energy market and security of supply in the Union.

The new Market Design Initiative proposes a more open market which has to look across borders, but there are some challenges for the new Regulation:

- National rules and practices tend to focus on the national context only.
- There is very limited sharing of information and transparency between Member States.
- Member States often take actions with their transmission system operators (TSOs), without informing others.

There exists a regulatory gap regarding this situation. The current EU legal framework (Directives 2005/89/EC [31] and 2009/72/EC [9]) only includes general objectives for security of supply, leaving Member States to decide how to achieve these. That means that the current legislation doesn't reflect the reality of the actual interconnected electricity market, where a crisis situation can affect several Member States at the same time.

The proposed regulations [27] [29] complements the revisions of the Third Package that are taken in place in parallel. This revision will aim to improve the functioning of the internal electricity market by allowing more flexibility and including a coordinated European long-term resource adequacy assessment. It will also aim to improve system security through better cooperation between TSOs at regional level via the creation of regional operational centres.

The proposed Regulation is consistent with existing legislation in the field of cyber-security and critical infrastructure. On cyber-security, Directive[13] (EU) 2016/1148 (the NIS Directive) [25] lays down general rules and the proposed Regulation will complement this directive by ensuring that cyber-incidents are properly identified as a risk and that measures taken to deal with them are properly reflected in the risk preparedness plans. The proposed Regulation complements also Council Directive 2008/114/EC[14] [32], which established a common procedure for identifying European critical infrastructures ('ECIs'). The proposed Regulation focuses more on how to secure the resilience of the electricity system as a whole and how to manage crisis situations when they occur.

3.4 WINTER PACKAGE REACTIONS FROM ENERGY COMMUNITY

Politicians

The Vice-President for Energy Union Maroš Šefčovič said [33]:

"The package will boost the clean energy transition by modernising our economy. Having led global climate action in recent years, Europe is now showing example by creating the conditions for sustainable jobs, growth and investment."

[13] Directive (EU) 2016/1148 (OJ L 194, 19.7.2016, p. 1-30).
[14] Council Directive 2008/114/EC (OJ L 345, 23.12.2008, p. 75).

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Commissioner for Climate Action and Energy Miguel Arias Cañete said [33]:

"Our proposals provide a strong market pull for new technologies, set the right conditions for investors, empower consumers, make energy markets work better and help us meet our climate targets. I'm particularly proud of the binding 30% energy efficiency target, as it will reduce our dependency on energy imports, create jobs and cut more emissions. Europe is on the brink of a clean energy revolution."

Member of the Parliament's environment, public health and food safety committee Peter Liese said [34]:

"In particular, I welcome the proposal on energy efficiency. The Commission has put energy efficiency first, not only in word but also through concrete action."

Operators of the system (transport and distribution)

Chief Markets and System Operations Officer at 50Hertz Dr. Dirk Biermann said [35]:

"There is a need for intensive cooperation between the European transmission system operators to create system security and uniform market conditions across national borders. A lot has happened in recent years. The Regional Security Coordinators (RSC) already make an important contribution here. This structure should be pursued in order to expand the cooperation rather than create completely new structures."

EDF said [36]:

"EDF welcomes the publication by the European Commission of the latest Energy Union Package. As a European leader in the electricity market, EDF will be paying close attention to the discussions on market design that are due to begin, to make sure that the rules introduced will deliver a better long-term visibility and create a level playing field for the different market players, and all different technologies. The Group would also like producers and suppliers to work together on all the actions and procedures designed to encourage regional and European market integration."

Energy supply companies - retailers

Director of Gas Natural Fenosa Antonio Canoyra said [37]:

"I dare to conclude that there is no doubt about the political commitment to the leadership of the European Union in the transition towards an energy system that is increasingly respectful of the environment, giving priority to efficiency, the development of renewables and the revitalizing role of the consumer in the operation of the electric market."

Professional or sectoral associations

Fundación para la Eficiencia Energética said [38]:

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"From Fundación f2e we believe that these measures will support the development of the photovoltaic market in Europe, allow buildings to become active elements of the energy system, as well as improve the integration and enhancement of the different renewable technologies in the electrical markets.

Now one just needs to know when the Spanish government will pay attention to these measures and will implement them in our country."

Secretary-General of ePURE (European Renewable Ethanol Association) Robert Wright said [39]:

ePURE regretted the European Commission's intentions to phase out, or significantly reduce, the use of conventional biofuels in Europe, contained in the proposed Renewable Energy Directive for the period post-2020. "This political decision is not justified and ignores the Commission's own science which shows that ethanol is a low carbon fuel. The biofuel sector feels betrayed by the Commission because of its complete disregard for the investments made in good faith on the basis of EU policy"

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4 MEMBER STATES REGULATORY STRUCTURE FOR DR

This chapter looked at nine European Member States, some of which were recognized 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, Denmark, France, Italy, Portugal, Spain, the Netherlands, and United Kingdom.

4.1 AUSTRIA

Implicit DR

In 2014, the law on energy efficiency was introduced in Austria which obliges large companies and governmental institutions to fulfil certain energy savings [40]. However, implicit measures targeting behavioural intervention are not covered by the methodologies to assess energy savings from the regulations. In Austria, a day-night tariff is common, and from February 2018 it is also possible for smaller connections to have a 15 min tariff. The contractual framework for flexibility does not make an exemption for connections with ToU tariffs, but the concept needs to be sound for prequalification by TSO [41]. Austria is aiming at achieving 95% of smart electricity and gas meter coverage by 2019. However, there is not yet a quantity discount in the implicit energy market; that is, costumers have no benefits from consuming more energy during the cheaper network tariff [42].

Explicit DR

While important regulatory barriers remain, which prevent small loads from participating due to low revenue streams [43], the Balancing Market in Austria has been open to aggregation and Demand Response since 2013 [42]. Prevailing barriers include that each consumer participating in the balancing market is required to install an expensive and dedicated telephone line.

Entry rules and pre-qualifications make the overall structure of the market (centralised-generation focused) overcomplicated and expensive. Hence, aggregators can only attract customers with large amounts of flexible load and/or back-up generation. The requirement of 4-hour minimum availability largely reduces the number of consumers than can participate.

Usage of flexibility is further hampered by the regulatory need to inform the BRP/retailer before using flexibility, which causes delays in deployment.

The most attractive market for DR in Austria lies in the ancillary services market. This includes tertiary control which has low entering barriers and low technical requirements, and the secondary control which is one of the few in Europe with short-term-auction based markets. In this market the consumer can change their consumption independently (asymmetrically) which is very attractive for many consumers [42].

Participation in the wholesale market is only available for aggregated generation. Although in principle, Virtual Power Plants could participate in the day-ahead market, there is no DR in this market.

4.2 BELGIUM

The basis of the Belgian regulatory framework for the electricity system is the Belgian Electricity Act of 29 April 1999. As a result of the complex federal system some subjects are dealt with on a federal

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level and some on a regional level (Brussels, Walloon and Flanders). The federal responsibilities include security of supply, the nuclear fuel cycle, production and federal supply licences, consumer protection and transmission tariffs. The regional responsibilities are energy efficiency, renewables, regional supply licences and distribution tariffs. Demand response is, in principle, seen as a federal matter [44] [45].

In Belgium for every single connection on the grid a balance responsible party is designated. Executing balance responsibility requires a contract with the Belgian TSO Elia and the BRP role is governed by the Grid Code [46]. BRP's are settled on portfolio basis [47]. The allocated volume is based on metered data for large connections and profiles in case of small connections without a 15 minute metering [48] [49].

Other roles defined in the Belgian Electricity market are the system operator, regulator and the supplier. Belgium is in the forefront in Europe because it is already creating a regulatory framework for demand response [50]. Based on a thorough study of the Commissie voor de Regulering van de Elektriciteit en het Gas (CREG) [51], revealing the legal as well as technical barriers[15] [52], the federal government issued an act which facilitates and stimulates the use of flexibility [53].

The specific characteristics of the Belgian energy market regulation regarding DR are:

- The Electricity Act creates the role of an independent Flexibility Service Provider (FSP), which enables direct participation by consumers as well as independent aggregation, although an FSP still needs a BRP to gain market access. A consumer is free to choose a FSP [54] [55];
- In the regulatory framework the broad definition 'net consumption' is used, so that flexibility covers adjusting the demand, the production or even use storage for DR[16] [52];
- A bilateral contractual model for the relation between the FSP and the BRP is assumed, although the Electricity Act comprises a fall back solution by regulator CREG, that uses the transfer of energy in case no bilateral agreement can be reached between the parties. In that case, a standard clause will govern the relation between the FSP and BRP;
- The end-user is entitled to his metering data for demand response purposes, while the TSO is the responsible party for the administration of the data. For end-users connected to the distribution grid, the TSO will have to seek cooperation with the regional DSO [56];
- An active role has been allocated to the federal regulator CREG in stimulating the evolution of demand side response within Belgium [57];
- When making a methodology for the transmission tariffs the CREG has to ensure that the energy efficiency in the market is ensured and that demand side response isn't hindered [58];
- A further elaboration of the framework regarding the Transfer of Energy and the standard contract clauses as well as securities provided by the FSP is still under discussion by the CREG [59];
- The current grid tariff structure needs to be changed to support effective DR services because it has a component based on the peak load for consumption [60];
- Smart metering for smaller connections has yet to be rolled out on a large scale [61];
- Not all Belgian imbalance products are open for the participation of DR, as secondary reserve isn't yet available and there are other specific products for production units larger than 25 MW that are not open to DR. Furthermore no DSO balancing services are available[17] [43].

[15] Vandorpe W, Callaerts R, in "Jaarboek Energierecht 2016", p.221.
[16] Vandorpe W, Callaerts R, in "Jaarboek Energierecht 2016", p.239.
[17] SEDC, in "Explicit Demand Response in Europe - Mapping the Market 2017", p. 49.

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4.3 DENMARK

The basis of the Danish regulatory framework for the electricity system is the Act No. 1329 of 25th November 2013 on the Supply of Electricity. For every single connection to the grid a BRP is designated. Executing Balance Responsibility requires a prior certification by the Danish TSO Energinet. BRP's are settled on portfolio basis [62]. The allocated volume is based on hourly meter data for large connections and profiles in case of small connections [63].

Danish 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. In theory, electricity consumers are allowed to participate in every ancillary service market. However, due to the regulatory environment, participation remains limited. DR hasn't been incorporated in the current legal framework in Denmark. However steps are taken by the Danish Energy Association developing a new market model for flexibility. [42] DR aggregation takes place only through retailers[18], and there are no independent aggregators in the Danish market today[19] [43].

The specific characteristics of the Danish energy market regulation regarding DR are:

- All Danish imbalance products are open to demand response, provided that the requirements given by the TSO are met [64];
- Wholesale market is open for demand response[20] [43];
- Parties providing flexibility services need a BRP to gain market access.
- Smart metering will be rolled out in Denmark [42] by 2020[21] [65].
- Currently no specific market role defined for delivering DR. Therefore the only possibility for parties providing flexibility services to establish contracts with the consumer as well as with the BRP/supplier regarding the contracted flexibility, the exchange of data and the remuneration.

4.4 FRANCE

Implicit DR

In France, there is a long tradition for implicit demand response achieving around 800 MW of consumption under DR schemes. However, to date there are no dynamic pricing offers yet available on the market. There are only simple pricing schemes, peak and off-peak and tempo tariffs (which have been available long before the implementation of smart meters). The Tempo tariff distinguishes different periods within the year, dividing it into days with cheap, average and expensive prices [66].

Customers have access to the Linky smart meter (Linky smart meters will communicate with data concentrators) that supports dynamic pricing and should enable advanced dynamic pricing tariffs. Linky has 10 possible indexes that correspond to 10 different pricing mechanisms. Linky is also able to pilot 8 domestic appliances, such as the electric heating system, however no such services are available today in the market [67]. It includes the functionality to provide data to the supplier or consumer with a frequency of 30 minutes. The consumers who have a PV installation can account for the power injected in the grid with the Linky meter.

[18] Bertoldi P, Zancanella P, Boza-Kiss B, in "Demand Response Status in EU Member States", p. 37.
[19] SEDC, in "Explicit Demand Response in Europe - Mapping the Market 2017", p. 58.
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The French regulator, Commission de régulation de l'énergie (CRE), approved in November 2016 the introduction of critical peak pricing (CPP) scheme in the TURPE 4 distribution tariff for medium voltage delivery (1kV to 50kV). CPP in low voltage has been rejected by the French regulator [43].

Explicit DR

France has a detailed framework in place for independent aggregators, including standardized roles and responsibilities of market players. In 2003 the balancing market was created in France, where demand facilities could also participate if they were connected to the TSO. In 2009-2013, a new law regarding demand response participating in the balancing market and spot market was passed. In 2014, the first 'Notification d'Échange de Blocs d'Effacement' (NEBEF) rules were introduced, allowing access of DR to day-ahead market. The NEBEF rules ensure access to the market for independent demand response aggregators. The markets included are the wholesale market, the capacity mechanism market and the market for manual frequency restoration reserves (frequency containment reserves, automatic frequency restoration, balancing mechanism). Aggregators can also participate in the balancing market, with a minimum capacity threshold of 1 MW. The NEBEF rules provide a compensation mechanism for offsetting bulk energy issue.

The aggregator does not need the agreement of the supplier of the impacted demand sites. However, remuneration for the shifted energy will still be transmitted to the suppliers for the energy they supplied to the impacted demand sites. The TSO keeps record of the transactions and allocates the supplied energy to the relevant supplier for each demand response activation.

Regarding the energy transfer for balancing perimeters, the TSO adds the demand response energy reduced with the shifted energy to the supplier's consumption in its balancing perimeters and to the resource in the aggregator balancing perimeter.

The NEBEF rules also require that to build its demand response perimeter, the aggregator must sign an agreement with the demand sites and declare them to the TSO (RTE) and DSO to which they are attached.

Since 2003, large industries could participate to balancing mechanism. In 2007, the first pilots were run to introduce aggregated residential loads to this mechanism. The capacity mechanism has been open since January 2017 for demand response and it is based on a decentralized market, meaning that market participants can contract directly under themselves. There are however limits to this aggregation, since bids can only include demand response only or generation only and not a combination of both.

4.5 ITALY

Implicit DR

Italy was one of the first countries in achieving 100% smart meters roll out. This allowed implementing new tariff schemes for the end users.

A two-tier pricing system came into force in 2010, for consumers equipped with the new reprogrammed electronic meters measuring consumption at various times of the day – provided they opt for continuing to benefit from the reference prices fixed by the Italian Energy Regulatory Authority. These two-tier prices were intended to favour direct savings and, a more equitable treatment of consumers, energy efficiency and environment protection. Today's commercial solution includes the opportunity of differentiating prices according to various times of the day. The two-tier tariffs were initially applied to all households still benefiting from regulated tariffs, i.e. households not having changed their electricity utility. Among the most significant proposals was the introduction of a transitional 18-month period (characterised by a slight difference in the prices applied at different time bands) to provide an initial, correct price signal, while ensuring the suitable phasing in of the new two-tier pricing system. When the

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system came into full operation, the difference between prices was rather directly proportional to the wholesale price of electricity at different time bands. In addition, to facilitate consumers' savings, through the more profitable shift of consumptions to less costly times of the day, the Authority proposed to immediately mitigate a few power-capacity constraints which occasionally cause meters to trip out when multiple appliances were used simultaneously.

With two-tier tariffs, electricity:

- Costs less from 7pm to 8am during weekdays and at any time on Saturdays, Sundays and other holidays – shown in the bill as time bands F2 and F3,
- Costs more from 8am to 7pm during weekdays – shown in the bill as time band F1.

Table 3 summarizes the current ToU in Italy.

	Weekdays	Saturdays, Sundays and Holidays
0.00 a.m. to 8.00 a.m.		
8.00 a.m. to 7.00 p.m.		
7.00 p.m. to 0.00 a.m.		

	Time bands F2 and F3, during which electricity will cost less
	Time band F1, during which electricity will cost more

Table 3. Italy. Time of Use tariff.

Explicit DR

In recent years, the Italian electricity market has been characterized by a 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 framework for consumer participation in the balancing market is not yet in place [43]. The only exception is the interruptible contracts program, which is a dedicated Demand Response program 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 utilization. The program has been called very few times during the past years, and in some cases never. Flexibility can access the day-ahead market, but only as demand bids with indication of price, as a balancing user (BRP). Although tenders for access to the new Capacity Mechanism were expected to start at the end of 2015, the process has not been implemented yet. The regulation of the Capacity Mechanism envisages the participation of Demand Response. The expected opening of balancing products to demand-side resources could lead to an increase of load participation. The potential progress is reflected in the new 2016 legislation, in which the Italian NRA (AEEGSI) defined the first phase of the Balancing Market Reform (RDE-1). The new agenda, whose implementation should start in 2018, will open the market to demand, distributed generation, RES, and high-performance co-generation. At the same time, it will regulate the access mechanisms of demand to balancing and reserve markets (including aggregation), reform balancing pricing, and revise geographic zone division.

4.6 PORTUGAL

Demand Response is not yet defined in the Portuguese legal system. However it is not illegal, even though Portugal has a large amount of generation capacity added to the capped electricity prices, so flexibility is not a short term priority. Portugal is interconnected to Spain and shares the same wholesale market, the MIBEL (Mercado Ibérico de la Electricidad), and balancing market structure.

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The role of independent aggregation of consumer load has not yet been defined and neither is there a base regulatory framework defining responsibilities, access rights, measurement, baseline, nor payment structures are in place yet, but the aggregation of distributed generation is enabled. An interruptible contracts program exists. This service does not allow aggregation and is limited to large industrial consumers with contracted power higher than 4MW, connected to the HV grid, where the largest consumers have a requirement to shed load during a system security event. It represents an available capacity of 2 GW of demand reduction in peak hours [43]. Industrial energy consumers involved in this scheme are construction industries or other material manufactories. Therefore, this participation is only in the ancillary services market for large roll-players.

In the wholesale market, only generators with a production minimum of 50 MW can participate as sellers in that market. Renewable flexibility resources can participate in the spot market, through demand bids with indication of price.

Network access tariffs are charged to all electricity consumers for the use of the infrastructure. These tariffs are typically paid by retailers on behalf of their customers. They may also be paid directly by customers benefiting from a market agent figure, which allow customers buying energy directly on the markets by those who are responsible for managing their programming imbalances.

Smaller customers have access to tariffs with different price per time periods since 1997, a “dynamic price” of 3-4 price time-bands per day [42], but most consumers have decided to remain on the flat controlled tariff scheme. The regulator is conscious that the mechanisms have yet to be put in place, which would enable Demand Response, so it is needed to carry out another regulatory review, which includes enabling of Demand Response. This may produce some opening of the market to give greater visibility to the possibility of Demand Response participation, although as of date no petitions for DR have come from the market.

Portugal, while open to the idea of Demand Response, remains a closed market mainly due to not having a regulatory framework defining roles and responsibilities, access rights, measurements, prequalification and all other technical required modalities which might pave the way for a clear path on consumer participation.

4.7 SPAIN

Aggregation is not legal in the Spanish electricity system, but even though aggregators are not recognised in Spain, the role of “representative” exists, which can sell energy in the name of their “representees”. A Demand Response scheme is not yet defined in Spanish law, there is only one program allowing explicit demand response, like in Portugal, called “the interruptible load”, which is reserved for large industrial customers connected to the high voltage grid [68]. This programme acts as an emergency action, in case the system is losing generation and the balance resources are not enough to cover all power. It is managed by *Red Eléctrica de España* which functions as TSO. The interruptible load programme doesn’t allow aggregated demand directly to the TSO nor to the DSO. When those large customers are connected to the DSO’s network, the DSO does not participate in the programme, and it is not even able to forecast it in advance. The participants must have in a specific ICT system, which links them directly to the TSO, and not to the DSO where they may be connected. As a consequence, retailer’s imbalance is directly managed by the TSO, which takes into account its reduction action. There is an available capacity of 2.000 MW of demand reduction in peak hours. In 2015, 3,020 MW of interruptible load was assigned; while in the auction for 2016, 2,890 MW of interruptible demand was assigned, with a total cost of €503 million [42].

In general, Demand Response does not have access to the balancing market nor to ancillary services, but since 2016, an exception occurs with generation based on decentralised renewable. Renewable energy resources (particularly wind generators) have been recognised and added to the tertiary reserve,

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which is an important development in paving the way for aggregated Demand Response to participate in this market. It is a matter of fact that the TSO and relevant stakeholders have started conversations for the future opening of these services to flexible demand.

In respect to the wholesale market, only generators with a production power of at least 50 MW can participate as sellers in that market. Flexibility resources are able to participate in the spot market through demand bids with indication of price [43].

Overall, while smart meters and dynamic pricing are already available for residential consumers, the Spanish market has been slow to enable consumer participation in any form of program. There is no possibility for aggregated demand side resources to take part in the Spanish electricity market yet, since demand response and aggregation are not enabled. There are no standards at the moment defining their relationship with the BRP and the TSO.

4.8 THE NETHERLANDS

The basis of the Dutch regulatory framework for the electricity system is the Dutch Electricity Act 1998. For every connection on the grid a balance responsible party (BRP) is designated. [69] For small connections this responsibility is allocated to the supplier, whereas large connections can choose their BRP independently of their supplier. [70] Executing Balance Responsibility requires a prior certification by the Dutch Transmission System Operator (TSO) Tennet, as well as signing a BRP contract. [71] BRP's are settled on portfolio basis. [72] The allocated volume is based on metered data for large connections and profiles in case of small connections (without a 15 minute metering).

Other roles in the Dutch Electricity market which are embedded in the regulatory framework are the system operator, supplier, regulator and the metering company. [73] The role of the Flexibility Service Provider (FSP) is not defined separately but is integrated in the BRP role. The delivery of flexibility services, such as demand response, is based on individual contracts between the customer and the party that provides flexibility services to the market. The latter can be an integrated supplier-BRP, a BRP, or a third party [41][22].

In the Netherlands most of the demand side flexibility is used in the so called passive balancing, based on the one sided and voluntary actions from BRPs to balance the grid without being actively selected via a bidding ladder. This structure is unique to the Netherlands [42][23]. [43]

The specific characteristics of the Dutch energy market regulation regarding DR are:

- All Dutch ancillary services may be delivered via DR, provided that the technically neutral requirements given by the TSO are met; [43][24]
- Congestion management services may be delivered via DR to DSOs on a case by case basis [74].
- As per 1st January 2017 smart metering allocation has been made possible for small connections, and these small connections are allowed to deliver DR services [75].
- As per 24th March 2018 the customer has the possibility to create several allocation points behind his connection, so that he can select a separate supplier and BRP for each of his allocation points [76].
- The grid tariff structure is not facilitating demand response due to the fact that only consumption (and not production) is charged with a transport independent tariff. As a result there is a different

[22] [41] See page 16, chapter 3.2. (Table)
[23] [42] See page 73.
[24] [43], See page 136.

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financial appreciation of produced or consumed electricity. This transport independent tariff is based on the highest peak load for the connection in the present calendar year [77].

- There is no specific FSP role defined in the market model that can deliver DR services independent of the BRP. Therefore, only by complying with the high entry barriers of becoming a BRP, a market party is allowed to deliver DR services.

4.9 UNITED KINGDOM

Implicit DR

UK has several measures that enable and develop energy demand response (DR). The structure of network tariffs in the UK encourages electricity and gas network users to avoid usage at times of peak demand. In addition, there is a location-based element to tariffs to ensure they reflect costs imposed by users at different points in the network. The suppliers are required to comply with the Smart Energy Code and formulate the requirements for smart metering systems. In addition, UK network tariffs allow suppliers to provide their customers with different prices for using the network, encouraging them to use less energy during the peak times with incentives.

The range of DR measures will be supported by the program of roll out of smart meters across Great Britain (GB) until 2020. For example, smart meters will record the time when energy is used and provide the necessary two-way communications between consumers and suppliers/other energy market participants, which will help facilitate time-of-use and other sophisticated tariffs. Near-real time information from smart meters will help to put consumers in control of their bills, leaving them better placed to reduce their energy consumption. The smart metering communications services was designed to be sufficiently flexible and scalable to support the increased communications and data flows that are expected to come from DR measures. In addition to this, the smart meter program sits at the heart of the efforts to empower consumers by providing them with access to the information they need to make informed decisions about their energy consumption.

Currently, there are some time-of-use (ToU) tariffs emerging, such as the Tide tariff, which works with a smart meter from Green Energy UK, that supports single tariff and 48 different ToU tariffs, as it is illustrated in Figure 2. However, there are no real-time tariffs yet available on the market [78].

The UK has also used SMETS2 meters (Smart Metering Equipment Technical Specifications: second version) [79], where ZigBee Sep/DLMS applications layer standard is mandated for Great Britain (GB) smart metering. Communication between devices and interoperability is included. Additionally, functionalities for smart grid are available, such as half-hour consumption data that can be recorded and communicated to the supplier or consumer. SMETS2 is designed to be capable of applying ToU pricing and of switching between different tariff registers once every 30 minutes. The switching between ToU bands and thus tariff registers is proposed to be based on the switching rules [80].

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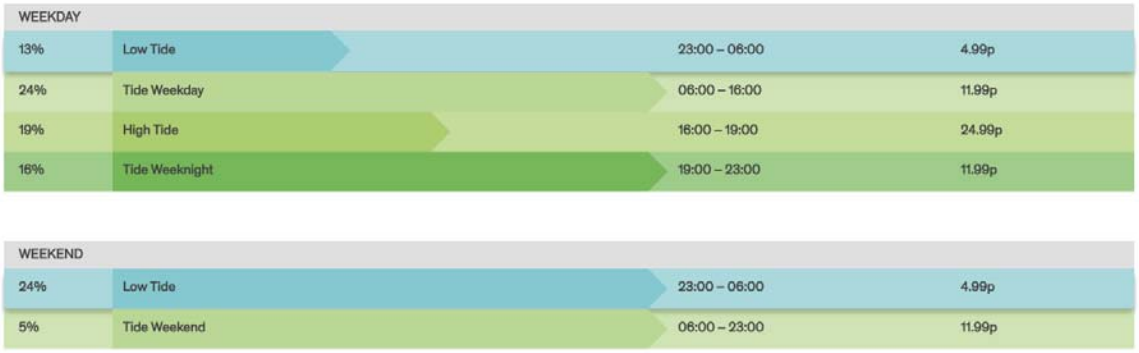

Figure 2. Time of Use tariffs in the UK from Green Energy.

Explicit DR

The UK allows aggregators to have some access to markets and products. The majority of the ancillary services market is available to demand-side participation. The Office of Gas and Electricity Markets (Ofgem) has an oversight of the forthcoming Capacity Market (CM), which will incentivize sufficient reliable capacity in both supply and demand sides to ensure a secure electricity supply, even at times of peak demand. The CM will include a program to grow the size and capability of GB's DR industry. The proposed charging system for the CM will be based on the share of customer market demand on winter weekday evenings, with the intention of incentivizing suppliers to reduce their demand through demand response and time-of-use tariffs [81].

The UK is now considering a framework for giving independent aggregators access to balancing mechanisms and wholesale electricity markets. The Energy Efficiency Directive (EED) [12] has been transposed into national law in the UK [82].

The Ofgem will oversee the upcoming capacity markets, which will include a plan to expand the size and capabilities of the UK demand response industry. Based on sharing customer market energy demand on the evening of winter weekdays, the Capacity Market utilizes the proposed charging system to incentivize suppliers to reduce their energy demand through time varying tariffs and demand response [83].

As Transmission System Operator, the National Grid is required to comply with its Transmission Licence (Condition C16) [84] that should not discriminate against any person or class of persons from using balancing services considering relevant technical and price differences. As one of the demand side providers, aggregators are actively encouraged by the National Grid to participate in the tender process of the standard market for ancillary and balancing services procurement. This requirement is not relevant to GB distribution system operators as there is no concept of dispatch within the distribution level [83].

According to Condition C16 [84], the National Grid published details of balancing services that aims at balancing demand and supply, and ensuring the quality and security of the electricity supply across the transmission system in GB. The balancing services [85] can either reduce the demand or utilize the on-site generation in demand side response, and introduce participating parties including:

- Large commercial and industrial customers;
- Small to medium enterprises; and
- Aggregators.

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5 POLICY AGENDA FOR DIGITAL CURRENCIES (Blockchain)

This section is devoted to understanding what Blockchain is, the role it could play in the development of demand response in the energy markets (section 5.1), the current regulatory framework in the European Union regarding Blockchain (section 5.2) and the policy agenda for Blockchain from the European Commission (section 5.3). As such, this chapter serves the purpose of establishing the regulatory requirements for digital currencies and blockchain technology in the EU to support the design of flexibility management components.

5.1 BLOCKCHAIN AND THE ENERGY MARKET

Blockchain is the best known distributed ledger technology. A ledger is a database which keeps a final and definitive record of transactions. While traditional ledgers have a central authority to control and register all transactions and records, the distributed ledger technology gives all users a copy of all the transactions which cannot be altered individually and where transactions that alter records are only approved if everyone agrees the transaction is valid. One application of the blockchain technology lies in blockchain-based currencies, where the largest one is Bitcoin [86]. For the application of blockchain technology in the energy market to work efficiently, there is also the need for smart contracts. A smart contract is software that runs not on a single server or a cloud, but simultaneously on all nodes of the Ethereum network. The software contains all agreements which can be conditional or not and are executed automatically [87].

A blockchain-based distributed ledger technology with smart contracts can be used for delivering transparent, secure, reliable and timely energy flexibility from prosumers to all the stakeholders involved in flexibility markets, such as DSOs and aggregators [88]. Via a pure, peer-to-peer, decentralized demand response management system, the programmatic definition of expected energy flexibility levels can be ensured, the demand response agreements can be validated and the energy demand and energy production can be balanced. By using blockchain technology, the energy transaction costs can be reduced while the system becomes more robust because it is not relying on a central authority, and, therefore, the system has no single point of failure [88].

5.2 CURRENT REGULATORY FRAMEWORK

While the potential for using the blockchain technology is there, for the development of using Blockchain in energy markets to take off, is necessary that a regulatory framework that allows energy and flexibility to be traded directly between prosumers and to other market parties without the need to go through a central authority is in place. The current market design has not taken this technology into account, so the regulatory framework of the EU member States is not yet fit for the development of local energy communities that exchange energy between them and deliver flexibility services to other market parties. Furthermore, the sharing of privacy-sensitive data among the network (such as consumptions, locations and financial transactions) in the Blockchain network would not comply with the General Data Protection Regulation (GDPR) that will enter into force in May 2018 [89].

The market design currently in place is based on a central trusted party that connects all other market parties and that facilitates the exchange of data. This does allow for the central party to let blockchain-based communication with assets that deliver balancing services. The transmission system operator TenneT has started a pilot in Germany in collaboration with the energy supplier Sonnen, where they use decentralized home energy storage systems networked via blockchain technology to stabilize the power grid. TenneT started a second pilot in the Netherlands, where they use the smart charging possibilities

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of charging poles to provide balancing services. Both pilots use a private blockchain instead of a public blockchain solution, so the transactions and data are not public and the solution can comply with the GDPR [90].

In the pilot “DEVO Netherlands District”, which is a part of the demonstration phase of DRIvE, a blockchain-based digital currency NRGCoin will be implemented to allow the direct trade of energy in a local energy community. The normal regulatory framework does not leave room for such an experiment, but there is a regulation called “Experimenten elektriciteitswet” that allows an exemption of the applicable energy law. In this regulation, market parties that are experimenting with decentred renewable energy production can ask to be excluded from all regulations in the energy law for a maximum period of 10 years [91].

A very early development in creating a new market model that takes advantage of the blockchain technology is being undertaken by Energy21 and Quantoz. They are setting up a framework that complies with the framework USEF, where prosumers and grid operators are being connected through a blockchain-based application [92].

5.3 POLICY AGENDA FOR DIGITAL CURRENCIES

The European Commission aims to develop a common approach on Blockchain technology for the EU in the international arena [93]. In May 2017, in the Digital Single Market mid-term review [94], the Commission recognised blockchain-based technologies as having a great potential for the administrations, businesses and the society of the European countries in general. Also, the Council conclusions of 19 October 2017 [95] highlight Blockchain as a "key emerging trend". To put the European Union in the front of the development of blockchain-based developments, the European Commission has launched the EU Blockchain Observatory and Forum in February 2018. The main goals of the observatory are to highlight key developments in blockchain technology, promote European actors and reinforce European engagement with multiple stakeholders involved in blockchain activities [96]. Besides the Observatory, the EC has been funding blockchain projects in research programmes FP7 and Horizon 2020 since 2013 and will continue to do so until at least 2020.

Although the EC is stimulating the development of blockchain-based applications, it is also working on regulation for digital currencies to address concerns about money laundering and terrorist funding. The first step for this process has started by defining virtual currencies in an amendment to the European Union Fourth Anti-Money Laundering Directive which is accepted by the committee and awaits Trilogue negotiations [97].

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6 CONCLUSIONS

The current regulatory environment affecting Demand Response is driven by a collection of recent directives that encourage EU Member States to support a technically neutral market that includes aggregation and supports energy efficiency efforts. These directives have been adopted in various ways by member states, with some nations (e.g. Austria, France, UK) already allowing explicit demand response through some form of aggregation of loads by residential and tertiary customers. Other nations (e.g. Spain, Portugal) still do not have clearly defined roles for aggregators or other parties that can enable these customers to compete effectively in the market.

The proposed Winter Package seeks to introduce consistency in these projects, and therefore will have a profound effect on many aspects of the DRIvE project. In particular, the introduction of the Market Design Initiative and the explicit definition of the roles and benefits for aggregators could lead to a more standardized electricity market across the EU. Additionally, updates to the EED and EPBD would explicitly allow self-consumption and could lead to more access to the tools necessary for unlocking flexibility in the residential and tertiary building sectors. With wide support for the Winter Package from various stakeholders, future developments in this regulation should be closely monitored throughout the duration of the DRIvE project.

The use of distributed ledger technology, such as Blockchain, with smart contracts for delivering DR services can significantly reduce transaction costs and increase overall security of the electricity system, making aggregation more appealing. However, the network security benefits require energy and flexibility to be traded without passing through a central authority, something that the data management and privacy rules outlined in the GDPR do not currently allow. The European Commission is actively reviewing legislation on this matter and future developments here should also be monitored.

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